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Jersey Strategic Flood Risk Assessment

Government of Jersey

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Quality information

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User Guide

This Level 1 Strategic Flood Risk Assessment (SFRA) report has been produced with a range of end users in mind – Government of Jersey, developers, flood risk consultants and emergency planners. The table below describes the sections of the SFRA and helps each user find key information in the SFRA for their use.

Section and Content Summary

		Flood Risk Information	Government of Jersey	Developers	Emergency Planners
1	**Introduction** An overview of the purpose and objectives of the SFRA		✓	✓	✓
2	**Island Plan Review** An overview of the Island Plan Review.		✓	✓	
3	**Methodology** An overview of the supplied data for use in the SFRA.		✓		
4	**Flood Risk Overview** An overview of the flood risk from all sources across the study area, including the impact of climate change where this information is available. Based on the data recorded in Appendix A and the mapping in Appendix B.	✓	✓	✓	✓
5	**Flood Risk Mitigation Measures in Jersey** An overview of current flood mitigation and management measures.	✓	✓	✓	✓
6	**Strategic Flood Risk Management** An overview of potential options for improved strategic flood risk management.		✓	✓	✓
7	**Flood Risk Framework** Recommendations for a Flood Risk Framework based on the findings of the SFRA.		✓	✓	
8	**Site-specific Flood Risk Management Measures** A summary of potential site-specific flood risk management measures that developers can use to manage the impacts of flooding to and from the site.		✓	✓	
9	**Cumulative Development and Land Use Change** An overview of the potential flood risk impacts from cumulative development and land use change.		✓	✓	
10	**Recommendations for Policy and Guidance**		✓		
A	Data Register List of all data used in the SFRA, including source, format and limitations.	✓	✓	✓	
B	Maps providing information on the different sources of flooding which affect Jersey.	✓	✓	✓	✓
C	Pumping Station Catchment Areas Maps providing information on the catchment areas for the main pumping stations in Jersey.		✓	✓	
D	Site Specific Flood Risk Assessments Guidance for developers undertaking a Flood Risk Assessment (FRA) for proposed development sites.		✓	✓	

1. Introduction

The Jersey Strategic Flood Risk Assessment (SFRA) provides an island-wide assessment of the risks associated with flooding from all sources, including the effects of climate change. The SFRA also provides guidance on the mitigation of flooding and identifies potential opportunities to reduce flooding.

The SFRA identifies methods to deliver strategic policies, which will support long-term flood risk management in Jersey. Through this, the SFRA will support current policy in Jersey including the Common Strategic Policy (2018-22), the Government Plan (2020-23) and Future Jersey (2017-2037), the Island's 20-year community vision. The SFRA will also feed into the Island Plan review process, forming part of the baseline evidence for flood risk and climate change. This will support the next iteration of the Island Plan which is due to be adopted and published in 2022 as the Island Plan (2022-24).

The development of the SFRA has been carried out broadly in line with the guidance on how to prepare a strategic flood risk assessment[1] for England, developed by the Environment Agency. However, as an independent island state, the SFRA does not need to strictly follow this guidance, and the SFRA has been tailored specific to Jersey and the requirements of the island.

The aims of the SFRA for Jersey are as follows:

- Identify the risk of flooding from all sources;
- Outline the potential cumulative impact that development or changing land use would have on the risk of flooding;
- Identify the potential effect of climate change on flood risk;
- Identify potential opportunities to reduce the causes and impacts of flooding;
- Develop a flood risk framework and supporting policy recommendations for consideration in the Island Plan review;
- Provide information on methods to manage and mitigate flood risk;
- Provide guidance on producing site specific flood risk assessments.

1.1 Study area overview

1.1.1 Island Parishes

The Channel Island of Jersey is divided into twelve administrative parishes. All have a coastal boundary and share a name with their ancient parish churches. The parish boundaries are shown on the figures within Appendix B. The risk of flooding from all sources of flooding to each of these parishes is discussed in Section 3.

1.1.2 Topography

Light Detection and Ranging (LiDAR) topographic survey data is presented in Appendix B Figure 1. The highest points on the island are approximately 110 to 140 metres Ordnance Datum (m OD) and are located in the north of the island, in the parishes of Trinity and St John. The lowest points approximately 10 m OD, are located along the coastline to the south, south-east and west. A number of valleys are also present across the island, sloping from the north of the island to the lower lying areas along the southern coastline.

Appendix B, Figure 1 Topography

[1] How to prepare a strategic flood risk assessment (Environment Agency, 2019). Available online at: https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment

1.1.3 Geology

The Jersey coastline is diverse in geology, and creates a landscape which is highly valuable, and draws in visitors. The Government of Jersey Integrated Landscape and Seascape Character Appraisal[2] defines the underlying solid and drift geology across the island. Cliffs are most prominent along the north and southwest coastlines, with elevated cliffs on the north coast made from hard volcanic rocks and granite. Those in the southwest are characterised by metamorphic granite and deports of porphyritic granite. Other headlands on the coast are less extensive in extent. The southeast and west areas of the coastline are composed of softer geology.

[2] Jersey Integrated Landscape and Seascape Character Appraisal (Fiona Fyfe Associates, 2020) available online at: https://www.gov.je/government/pages/statesreports.aspx?reportid=5271

2. Island Plan Review

2.1 Island Plan

The Government of Jersey is currently preparing the Island Plan review, which will guide development in Jersey. In 2019 the Minister for the Environment launched the Island Plan Review Programme, with a view of developing a new 10-year Island Plan for the 2021 to 2030 period. However, the impact of the Covid-19 pandemic has meant that it is no longer possible to deliver an Island Plan as originally envisaged. To best respond to the current context, the Minister is developing a shorter-term 'bridging' plan that will exist between two longer-term plans (the current Island Plan 2011 to 2021; and a future Island Plan 2025 to 2034). The new bridging Island Plan will set the means to facilitate the island's positive future growth over a period of significant uncertainty and provide a new framework against which planning decisions will be made. The plan is key to delivering sustainable development; balancing the future economic, environmental and social needs of the island in a way that is best for Jersey and which reflects the vision and aspirations of islanders.

The Government of Jersey adopted the current Island Plan in 2011, however, much has changed since then and there is a need to respond to current economic, environmental and social challenges faced by the island. The review of the Island Plan will need to consider how best to address:

- the need for homes;
- safeguarding the environment;
- supporting the economy;
- mitigating the impacts of climate change;
- responding to an ageing population; and
- securing good design and creating better places.

The Government of Jersey is aiming for the Island Plan (2022-2024) to be adopted in 2022.

2.1.1 Managing growth

The objective of the Island Plan is to deliver sustainable development where a balance is struck between the need to protect the sensitive coast, countryside, biodiversity, and heritage assets, and the need to develop new housing, land for employment opportunities, major public infrastructure and community facilities, including open space and an improved public realm.

Previous Island Plans have focused on allocating new development in and around established centres. Historically, the town of St Helier has absorbed much of the island's growth, spilling beyond the boundaries of the parish of St Helier to embrace parts of the parishes of St Saviour and St Clement. This leaves 85% of the island as open countryside.

The Government of Jersey has proposed six broad spatial options for development within their Stage 1 Strategic Issues and Options consultation undertaken as part of the Island Plan Review[3]. These options have been summarised in Table 2-1.

[3] Island Plan Review 2021 to 2030, Stage 1: strategic issues and options consultation, (n.d), Available online at: https://www.gov.je/Government/Consultations/Pages/IslandPlanReviewStage1.aspx

Table 2-1 Strategic Spatial Options considered for the Island Plan (2021-2030)[4]

Strategic Spatial Option	Description
Option 1: Increasing density within the town of St Helier.	The town of St Helier stretches from First Tower in the west, to La Pouquelaye in the north, and Grève D'Azette in the east. Increasing the density of new development here would maintain and give greater emphasis to the existing policy direction of the current Island Plan.
Option 2(a): Outward expansion of town to the north, east and west	The urban fringes of the town comprise open countryside that could be developed to help meet development needs. Building on the edge of town would represent a change from the current Island Plan.
Option 2(b): Outward expansion of town to the south	There is also potential to change the existing use of parts of the harbour to enable the expansion of the town to the south. Such schemes would need to be commercially viable and address current safety issues. The current Island Plan includes the development of the St Helier Waterfront, which is effectively an expansion of the town to the south
Option 3: Increasing density in other built up areas	Other built-up areas include the coastal strip from St Aubin to Gorey; Red Houses and Les Quennevais; and a range of smaller built-up areas including parish centres. Increasing the density of new development here would maintain and give greater emphasis to the existing policy direction of the current Island Plan.
Option 4: Outward expansion of other built up areas	The edges of the other built-up areas (described under Option 3) generally comprise open countryside. Most is currently defined as Green Zone, but some is within the Coastal National Park. Some of the land on the edges of existing built areas could be used to help meet development needs. Expanding these built-up areas, by releasing land on the edge of them for new development, would represent a change from the policy direction of the current Island Plan.
Option 5: A new settlement or the significant expansion of an existing settlement	The boldest option would be to create a new settlement, or significantly expand an existing one. The development of a significant amount of new housing in Les Quennevais and Maufant are examples of this approach, where it has been undertaken in the past. This would likely require an extensive process of land acquisition and the development of open countryside. This would represent a significant change from the policy direction of the current Island Plan.
Option 6: Development in the countryside	This option would involve relaxing rules about converting, demolishing and rebuilding, and extending existing buildings in the countryside. It would mean increasing the density of development in the countryside and developing more areas of under-used or open land around the edge of existing clusters of buildings in the countryside. The redevelopment and consolidation of buildings or building clusters in the countryside would represent a significant change from the policy direction of the current Island Plan.

[4] Island Plan, Strategic issues and options. (n.d) Available online at: https://www.gov.je/SiteCollectionDocuments/Environment%20and%20greener%20living/ID%20Island%20Plan%20Review%20Stage%201%20AM.pdf

Following the public consultation on these options, held in Summer 2019, the responses received showed most support for focussing development within St Helier (Option 1), including expansion of the town to the south (Option 2b), with a strong resistance to development within the countryside[5]. The preferred spatial strategy, which was assessed relative to the current challenges that the island faces, has been published by the Government of Jersey[6] and is summarised below:

- focus development in the Town of St Helier:
  - facilitate the development of key urban opportunity sites; and
  - use public land to meet immediate needs.
- generally maintain the existing definition of built-up areas:
  - encourage the re-use and redevelopment of already developed land at higher densities, appropriate to the context.
- enable the sustainable and proportionate growth of some built-up areas – involving:
  - the planned release of greenfield land including;
  - extending some built-up area edges; and
  - around some parish centres, where this contributes to the overall community wellbeing and sustainability of an existing settlement.
- limit development around the undeveloped coast and in the countryside to those uses which require a specific location.
- positive consideration of future land-reclamation proposals in St Helier.

This SFRA provides background information to ensure that the materiality of flood risk is considered as part of the Island Plan Review and for the assessment of individual sites.

[5] Findings Report: Island Plan Strategic issues and options consultation (Government of Jersey). Available online at https://www.gov.je/SiteCollectionDocuments/Planning%20and%20building/IP-findings%20report-digital%20111219.pdf
[6] Preferred Strategy Report: Island Plan Review – Technical Evidence Base (Government of Jersey). Available online at https://www.gov.je/SiteCollectionDocuments/Planning%20and%20building/201022%20R%20Island%20Plan%20Review%20Preferred%20Strategy%20Report%20FINAL.pdf

3. Methodology

3.1 Overview

The methodology for the assessment of flood risk from all sources is outlined below; Section 3.4 provides a description of the datasets used to assess the risk of flooding from each source, further details of which are included within the data register in Appendix A.

3.2 Understanding flood risk

3.2.1 What is flood risk

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when people, human, and environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land and environmental and cultural heritage. Major sources of flooding include:

- **Coastal** – inundation of floodplains by the sea; overtopping of defences; breaching of defences; wave action, as summarised in Figure 3-1.
- **Inland** – inland flooding covers two main sources including overland run-off from adjacent land (also referred to as pluvial or surface water) and out of bank flow from watercourses (this can result from natural water levels exceeding the bank levels, blockage of culverts or bridges etc.).
- **Sewer** – surcharging of piped drainage systems (public sewers, highway drains etc.).
- **Groundwater** – caused by the water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying areas underlain by permeable rock (aquifers); groundwater recovery after pumping for industry has ceased.
- **Infrastructure failure** – reservoirs; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Flooding can also occur from a combination of many different sources.

Figure 3-1 Summary of coastal flooding mechanisms[7]

[7] Jersey Shoreline Management Plan (2020). Available online at https://www.gov.je/government/pages/statesreports.aspx?reportid=5173

Flood risk is the product of the likelihood (or probability) of flooding and the consequence of flooding. The consequences of flooding can vary based on the vulnerability to flooding (taking into account any flood defences and the potential for those defences to breach, fail or be overtopped) and the total value of the assets at risk of flooding (population and development). With investment in flood protection or the changing/managing of the location of assets in flood risk areas, the risk of flooding will be reduced.

The risk of flooding is assessed using the source – pathway – receptor model (as shown in Figure 3-2). This method is a standard environmental risk model, common to the identification of environmental hazards and is the starting point of identifying receptors at risk of flooding. For a flood risk to be present there has to be a source (for example, sea or rainfall), pathway (for example, overtopping, asset failure, exceedance or overland flow route) and receptor (for example, people, property and the environment). The consequences are varied and can include loss of life, stress, material damage, loss of land, environmental degradation, cultural loss and economic impact.

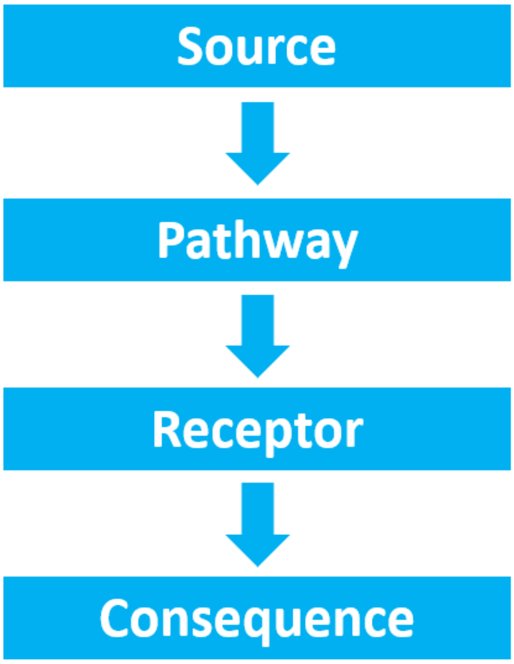

Figure 3-2 Source Pathway Receptor Model

Different types and forms of flooding present a range of different risks. The speed of inundation, depth and duration of flooding can vary greatly between different flood events. With climate change, the frequency, pattern and severity of flooding are expected to change and become more damaging.

3.2.2 Defining the likelihood of flooding

The likelihood of flooding is expressed as the percentage probability and/or return period, as outlined in Table 3-1. The percentages are based on the average frequency measured (or extrapolated) from records over a large number of years. The lower the percentage, the less chance there is of that flood event happening in any given year; the higher the percentage then the more chance there is of that flood event happening in any given year. Although rare, floods with a low probability are likely to have greater impacts that are often far more severe compared to the high probability, more frequent, events.

Table 3-1 Expressing the probability of flooding

Probability	Percentage range	Return period (years)
High	Greater than 1.3%	1 in 75 or greater
	Between 0.5% - 1.3%	Between 1 in 200 to 1 in 75
Low	Less than 0.5%	Less than 1 in 200

3.2.3 Consequences of flooding

The consequences of flooding vary between different flood events, and can result in property damage, disruption to lives and businesses and personal implications for people (e.g. financial loss, emotional distress and health problems). Consequences of flooding depends on the severity of the flooding, and is influenced by the following factors:

- Depth of flood water
- Velocity of flood water
- Rate of onset
- Duration
- Wave action effects
- Water quality

The vulnerability of receptors also has a significant impact on possible damage and additional consequences caused by flooding. The potential for damage can be influenced by the following factors:

- type of development
- age-structure of the population
- presence and reliability of mitigation measures

The combined influence of these factors will determine the potential flood risk in any area.

3.3 Actual and residual risk

Flood risk is not static, as it cannot be described simply as a fixed water level or an area at risk if flooding was to occur. Risk varies depending on the severity of event, the source, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors.

3.3.1 Actual risk

Actual risk is the risk taking into account any flood management measures that are in place. Flood management measures typically provide a minimum Standard of Protection (SoP) which can vary between different defence types and different areas.

It is important to recognise that risk comes from many different sources and that the SoP provided will vary. The actual risk of flooding from the tide may be low to a settlement behind a coastal defence but moderate from inland sources, which may pond behind the defence in low spots and is unable to discharge into the sea during high water levels.

3.3.2 Residual risk

Even when flood management measures are in place there is always a possibility that these could be overtopped or exceeded or that they could fail or breach. In areas where this could occur, there is still a risk of flooding. This is known as a residual risk. Flood management infrastructure failure can lead to rapid inundation of fast flowing and potentially deep floodwaters, which may pose significant risk to the people, property and environment. Because of this, it is never appropriate to class an area as ‘not at risk’ due to flood management measures being in place.

3.4 Data collection

A large quantity of information and datasets have been made available by the stakeholder organisations and used to inform the assessment of flood risk. Descriptions of the datasets that have been used, along with details of their appropriate use or limitations, are included in Appendix A Data Register. These datasets have been used to develop the maps included in Appendix B.

3.5 Assessing each source of flooding

The identification of data sets and areas at risk of flooding has been carried out broadly in line with the guidance on how to prepare a strategic flood risk assessment[8] for England, developed by the Environment Agency. However, as an independent island state, the SFRA does not need to strictly follow this guidance, and the SFRA has been tailored specific to Jersey and the requirements of the island.

3.5.1 Coastal flood risk

Coastal modelling from the Jersey Shoreline Management Plan (SMP)[9] has been used to identify the areas at risk of flooding from the sea. The modelling included Still Water Level Flooding Analysis (excluding the presence of flood defences) as well as including the analysis of the effects of climate change to 2120. This modelling produced flood frequency outlines as return periods. The flood frequency has been expressed as annual exceedance probability (AEP)[10], which is the probability of that flood event occurring in any given year. The modelled flood events have been identified below ranked from the lowest risk to the highest risk.

- 1 in 200 year Return Period (0.5% AEP)
- 1 in 75 year Return Period (1.33% AEP)
- 1 in 20 year Return Period (5% AEP)
- 1 in 1 year Return Period (100% AEP)

The following return periods were modelled to account for climate change:

- 1 in 200 year Return Period (0.5% AEP) including short (2040), medium (2070) and long-term epochs (2120) to account for climate change.
- 1 in 75 year Return Period (1.33% AEP) including short (2040), medium (2070) and long-term epochs (2120) to account for climate change.
- 1 in 20 year Return Period (5% AEP) including short (2040), medium (2070) and long-term epochs (2120) to account for climate change.
- 1 in 1 year Return Period (100% AEP) including short (2040), medium (2070) and long-term epochs (2120) to account for climate change.

For the assessment of coastal risk, **high risk** has been identified using the 1 in 200 year outline (0.5% AEP) for the present day and **medium risk** has been identified using the 1 in 200 year outline (0.5% AEP) for 2120. This return period was chosen due to the size of the flood extents creating the worst-case scenario for coastal flooding; and for consistency with the established approach used in parts of the United Kingdom.

The coastal modelling assessed the risk of the overtopping of some of the existing defences. This data has been used to identify areas potentially at risk of flooding as a result of overtopping and areas in which improvements will be needed. Wave overtopping modelling was undertaken for the following high priority areas:

- St Ouen's Bay
- St Brelade's Bay
- St Aubin's Bay
- Havre des Pas
- La Grève D'Azette

[8] How to prepare a strategic flood risk assessment (Environment Agency, 2019). Available online at: https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment
[9] AECOM (2019), Jersey Shoreline Management Plan, Available online at: https://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=5173
[10] Annual exceedance probability is the chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is usually expressed as a percentage. Bigger rainfall events occur (are exceeded) less often and will therefore have a lesser annual probability.

- La Mare
- Le Nez Point to Le Hocq Point
- La Rocque
- Royal Bay of Grouville, and,
- Archirondel (north).

Information on coastal flood defences as well as current and future management interventions have been taken from the Jersey Shoreline Management Plan and information provided by the Government of Jersey. A list of the data sources provided for this assessment has been included in Appendix A.

3.5.2 Inland flood risk

Surface water hydraulic modelling was undertaken for the whole island as part of the SMP using a 2D TUFLOW model. The topographical data used was a composite Digital Terrain Model (DTM) with a 1m grid resolution sourced from the 1m LiDAR supplied by Government of Jersey (2017). The 2D TUFLOW model was set up with a grid resolution of 5m. This was chosen as 5m resolution represented the finest resolution that could be achieved whilst retaining practical model run times. Due to the scale and resolution of the island-wide hydraulic model, structures were included through filtering of LiDAR DTM data and provide a worst-case assessment of flood risk. Buildings were represented in the model by raising threshold levels by 0.3m above LiDAR DTM within the 2D domain.

In surface water hydraulic models, rainfall boundaries are usually applied across the entire model domain. In this case, the model domain was determined as being the whole island of Jersey. Therefore, a large proportion of the grid will present very shallow depths prior to runoff, and as such, the model results are filtered to be presented as mapped results. Areas of surface water flood depth of less than 0.1m were removed to present a clearer representation of flood risk. Further details on the modelling methodology are available within Section 8 of the Hydraulic Modelling Report technical appendix of the SMP[11].

The modelling was completed in line with UK Environment Agency surface water flood maps, and the results were presented as areas of low, medium and high risk of flooding.

- **High risk** of flooding means the area has a chance of flooding corresponding to a 1 in 30 year return period event (3.33% AEP);
- **Medium risk** of flooding means the area has a chance of flooding corresponding to a 1 in 100 year return period event (1% AEP); and,
- **Low risk** of flooding means the area has a chance of flooding corresponding to a 1 in 1000 year return period event (0.1% AEP).

Sensitivity analysis was undertaken on the three return periods for two storm durations (2 hour and 6 hour) and three continuing loss (infiltration) rates (6.5mm/hr, 12.5m/hr, 18.5mm/hr).

The assessment of inland flood risk has been carried out using the 1 in 30 year, 1 in 100 year, 1 in 1000 year outlines for the 2 hour storm duration with 6.5mm/hr continuing loss rate. This scenario was chosen as it displays the worst-case extent of inland flooding.

Modelling was also undertaken for two return periods (1 in 30 year and 1 in 100 year) for two climate change uplifts (+20%, and +40%). These scenarios have been mapped as part of the SFRA to account for the potential impact of climate change.

[11] Jersey SMP Appendix B – Hydraulic Modelling Report available at https://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=5173#:~:text=The%20Jersey%20Shoreline%20Management%20Plan,years%20(up%20to%202120).

Modelling was also undertaken for four surface water pumping stations (Baudrette Brook, Bel Royal, Samarês Marsh and West of Albert), to determine the effect they will have on flood risk to Jersey. Their locations can be viewed in Figure 5-1 in Section 5.1.2 of this report. The model and results represent a best case scenario in which all the pumps at the four pumping stations are in good condition, well-maintained and are in operation for the whole simulation at the maximum pump rate.

Information on mitigation measures as well as current and future management interventions has been taken from the Jersey Shoreline Management Plan and information provided by the Government of Jersey. A list of the data sources provided for this assessment has been included in Appendix A.

3.5.3 Groundwater flood risk

It has been identified by the Government of Jersey and Jersey Water that due to the geology of the island, groundwater flooding is not a significant risk. There are locations in the island in which groundwater is accessible, however these are not located near development and are used as a source of potable water. the risk of flooding from groundwater to the island has, therefore, been excluded from the rest of this assessment.

3.5.4 Sewer flood risk

The risk of sewer flooding has been assessed using the Government of Jersey flooding hotspots data. This data has been used to identify areas which may have previously experienced sewer flooding. It should be noted that this data is currently being updated by the Government of Jersey and is subject to revision.

3.5.5 Reservoir flood risk

The assessment of flood risk from reservoirs has been completed using information provided by the Government of Jersey and Jersey Water. Modelling of the possible flood routeing and predicted depth and velocity of water from the Grands Vaux Reservoir has been taken from the Grands Vaux Flood Plan. A list of additional data sources provided for this assessment has been listed in Appendix A.

4. Flood risk overview

This Section provides the strategic assessment of flood risk from each of the sources of flooding across the Island of Jersey. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix B.

4.1 Coastal flooding

4.1.1 Physical structure of the coast

The Jersey coastline has evolved over time, influenced by geology, coastal processes and human interaction. The island encompasses a diverse range of natural features, the interactions between which have combined to create the unique character of the coastline. These physical features of the coastline can influence the way the urban environment inland is developed and can determine the types of coastal defences which are appropriate for defending against coastal erosion and flooding. The Jersey coastline is dynamic, and change is predicted to influence the boundary between land and sea over the next 100 years. Climate change is predicted to cause rising still water levels, which will cause increased wave heights and increased severity and occurrence of storms. This will increase the risk of coastal flooding on the island in the future.

4.1.2 Risk of flooding from the tide

The risk of coastal flooding is very varied across the island with some areas at limited risk, and others at significant risk. Appendix B Figures 2 and 2A-2H identify the baseline coastal flood risk: this is where the risk of flooding is modelled without the presence of any flood defences. The approach to future coastal flood risk management measures for the island is set out in the Jersey Shoreline Management Plan (refer to Section 5.2.1). Areas of existing development that are located in an area at high risk of coastal flooding in each parish have been discussed in Table 4-1. It should be noted that the modelled outputs represent the present day flood risk from the still water level. There are areas that are known to flood (such as Beaumont and St Aubin) which are not identified at high risk of flooding from the still water level, but it is acknowledged that these areas can flood as a result of a number of contributing factors including wave overtopping.

Appendix B Figure 2 and 2A-2H

Table 4-1 Areas of development modelled to be at high risk of flooding from the tide (present day, not including the presence of defences)

Parish	Summary of present day coastal flood risk	Corresponding map
St Helier	The majority of the Parish of St Helier is not in an area at risk of coastal flooding. Flood water is restricted to the coastline along the parish edge within St Helier and Havre des Pas. Parts of the Port of St Helier are also identified as being at risk if coastal flooding was to occur.	Figure 2F and 2G
St Saviour	The Parish of St Saviour has a small coastline limited to the area of Le Dicq slipway which is at risk of flooding. Hotel de Normandie is directly opposite Le Dicq slipway and in very close proximity to the seawall that overtops.	Figure 2H
St Clement	There is considerable urban development along the majority of coastline in the Parish of St Clement. Flood water is restricted to the coastline along the parish edge, including La Mare slipway (opposite Rue de Maupertuis).	Figure 2G and 2H
Grouville	There is considerable urban development along sections of the coastline in the Parish of Grouville. Le Hurel slipway (adj. Grande Route des Sablons) is identified as being at risk from coastal flooding	Figure 2H
St Martin	Gorey Pier and harbour are identified as being at risk from coastal flooding.	Figure 2D and 2H
Trinity	There is limited urban development along the coastline in these parishes and the majority of development is on land above or set back from the coastline. No residential or commercial development is present in areas at	Figure 2C and 2D
St John		Figure 2B and 2C
St Mary		Figure 2A and 2B

Parish	Summary of present day coastal flood risk	Corresponding map
St Ouen	risk of flooding. Flood water is predominantly restricted to the coastline along the parish edge.	Figure 2A and 2E
St Peter		Figure 2E and 2F
St Brelade	The majority of development is set back from the coastline. No residential or commercial development is present in areas at risk of flooding. Flood water is predominantly restricted to the coastline along the parish edge.	Figure 2E and 2F
St Lawrence	Development in this area is predominantly located along the waterfront however flood water is predominantly restricted to the coastline along the parish edge.	Figure 2F and 2G

4.1.3 Climate change

Climate change poses a significant risk to the Jersey coastline. The effects of climate change on coastal flooding include:

- Rising still water levels
- increased wave heights
- increased severity and occurrence of storms.

These changes will increase the risk of coastal flooding in the island in the future. The impact of climate change on areas at risk of coastal flooding has been assessed using three epoch scenarios. These scenarios are:

- Short term (2040)
- Medium term (2070), and
- Long term (2120).

The future impact of climate change on flood risk was assessed using the UK National Oceanography Centre guidance. The 50th percentile results for the Intergovernmental Panel on Climate Change (IPCC) 'RCP8.5' climate change emission scenario ("business as usual") have been used. This gives a resulting sea level rise prediction of 0.83 metres by 2120.

Appendix B Figures 3 and 3 A-H

The areas of existing development at risk of coastal flooding (as a result of climate change) in each parish have been discussed in Table 4-2.

Table 4-2 Areas modelled to be at risk of flooding from the tide as a result of climate change

Parish	Areas identified at risk of coastal flooding in the future	Climate Change scenarios that would affect the area	Corresponding map
St Helier	Parts of the Port of St Helier	Short term (2040)	Figure 3F and 3G
	Parts of St Helier town centre	Short term (2070)	
	Wider Port of St Helier	Long term (2120)	
	Wider area within Havre des Pas	Long term (2120)	
	Parts of Victoria Avenue	Short term (2040)	
St Saviour	Parts of Georgetown, Grève d'Azette and Rue des Pres	Medium (2070) to Long term (2120)	Figure 3G
St Clement	Grève D'Azette, St Clement Golf Course, Plat Douet, Samarès and Rue des Prés	Medium (2070) to Long term (2120)	Figure 3G and 3H
	Le Hocq	Long term (2120)	
Grouville	Le Hurel	Medium (2070) to Long term (2120)	Figure 3H

Parish	Areas identified at risk of coastal flooding in the future	Climate Change scenarios that would affect the area	Corresponding map
	Rue de la Forge, Royal Jersey Golf Club Grouville Common, Grouville Marsh	Long term (2120)	
	Grouville Marsh	Short (2040) to Long term (2120)	
St Martin	Gorey Promenade and Pier Gorey Harbour; Gorey Village Anne Port and Archirondel	Medium (2070) to Long term (2120)	Figure 3D and 3H
	RNLI St Catherine's Bay (Lifeboat Station), Rozel	Short (2040) to Long term (2120)	
Trinity	Rozel	Short (2040) to Long term (2120)	Figure 3C and 3D
	Bouley Bay	Long term (2120)	
St John	Bonne Nuit Pier	Long term (2120)	Figure 3B and 3C
St Mary	Grève de Lecq	Medium term (2070)	Figure 3A
St Ouen	Grève de Lecq	Medium term (2070)	Figure 3A
	L'Etacq	Medium (2070) to Long term (2120)	
St Peter	Beaumont, Goose Green St Aubin's Bay promenade Le Marais	Long term (2120)	Figure 3F
St Brelade	St Brelade's Bay	Short (2040) to Medium term (2070)	Figure 3E and 3F
	St Aubin St Aubin's Bay promenade	Short (2040) to Long term (2120)	
St Lawrence	Bel Royal St Aubin's Bay promenade	Long term (2120)	Figure 3F

4.1.4 Areas benefiting from defences

There are extensive man-made coastal defences present around parts of the island's coastline, which are further described in Section 5.1.1. Some of these defences are higher than the still water level tide which reduces the risk of flooding. Appendix B Figure 9 identifies the areas benefiting from coastal defences where the defence is higher than the still water level tide during a high risk coastal flood event in 2120.

Appendix B Figure 9

4.1.5 Wave overtopping

Coastal flooding has the potential to have significant implications on urban areas in Jersey if flood defences are overtopped or are breached. Wave overtopping modelling was undertaken for the following high priority areas:

- St Ouen's Bay
- St Brelade's Bay
- St Aubin's Bay
- Havre des Pas
- La Grève D'Azette
- La Mare
- Le Nez Point to Le Hocq Point
- La Rocque

- Royal Bay of Grouville, and,
- Archirondel (north).

Appendix B Figure 10 and Figures 10 A-H identifies the areas at risk from overtopping during a high risk coastal flood event in 2040. The potential depth of flooding (in metres above the existing ground level) is also indicated on the maps.

Appendix B Figures 10 and 10 A-H

4.1.6 Historic coastal flooding

The Government of Jersey has provided information on historic coastal flooding in the island. Records of historic coastal flooding are listed in Table 4-3.

Table 4-3 Records of historic coastal flooding

Date	Parish	Details
3 January 2018	St Helier St Ouen St Peter	Storm Eleanor causes coastal flooding which closes roads and increases water level within watercourses. A section of sea wall collapsed at St Helier. Victoria Avenue was closed while Gloucester Street/Esplanade area and Five Mile Road also flooded[12].
3 March 2014	St Ouen St Helier	High tide (12m) and heavy winds combine to cause flooding. Rue Verte at L'Etacq severely damaged by the high tides. Victoria Avenue closed[13].
2 February 2014	Unknown	Coastal flooding associated with storms. Coastal roads flooded[14].
17 October 2012	Unknown	High tides cause flooding to various areas, including Beaumont[15].
8 March 2008	St Brelade St Helier St Lawrence	Storm Johanna causes flooding. Water overtopped flood defences which were breached in four locations. Victoria Avenue was closed at First Tower. Roads flooded in St Aubin, La Haule, Beaumont and The Gunsite. The sea wall was damaged at West Park with flooding onto Victoria Avenue, West Park, Esplanade, Gloucester Street and Seaton Place. Houses and businesses in this area were also flooded[16 17 18 19].
23 November 1984	St Helier	Severe storm noted for comparison with March 2008 event. Flooding in St Helier[19]. Seawall between First Tower and West Park damaged. Properties flooded First Tower to Castle Street.
27 February 1967	St Helier	Severe storm noted for comparison with March 2008 event. Flooding affected St Helier and was exacerbated by heavy rain[19].
October 1965 October 1964	Unknown	Severe storm noted for comparison with March 2008 event, but no further information given[19].

It should be noted that a decrease in coastal flooding at St Helier was observed following the land reclamation which was undertaken during the 1970s.

The Government of Jersey Department for Infrastructure, Housing and Environment has noted a number of observations from historic coastal flood events within different parishes, as detailed below:

- St Helier - historic flooding of properties and roads along the First Tower to Bay View section of Victoria Avenue. Coastal flooding has reached as far as Mont Cochon and Tower Road. Properties flooded between the slip road and Paris Lane.

[12] Jersey Evening Post (2018) *Jersey suffers coastal flooding*. Available online at: https://jerseyeveningpost.com/news/2018/01/03/jersey-suffers-coastal-flooding/
[13] (2014). *Channel Islands flooded after 'highest tide of the year'*. Available online at: https://www.bbc.co.uk/news/world-europe-jersey-26390204
[14] https://www.youtube.com/watch?v=tdO18kuP870
[15] https://www.youtube.com/watch?v=vPlYf8u5jMs
[16] Jersey Evening Post (2018). Available online at: https://jerseyeveningpost.com/news/2018/01/02/jersey-facing-biggest-flooding-threat-since-the-storm-of-march-2008/
[17] ARUP. (June 2017) *Jersey Future Hospital Flood Risk Assessment.*
[18] Surge Watch (n.d) *Storm Event 10th March 2008.* Available online at: https://www.surgewatch.org/events/12/
[19] The exceptional tide, storm survey and damage on 10 March 2008, as of 1 May 2008. Frank Le Blancq and John Searson, Jersey Meteorological Department, May 2008.

- St Martin - historic flooding of properties at Gorey Pier and harbour has occurred.
- St Mary - Café Romany, at Grève de Lecq has flooded.
- St Peter - major flooding of the Beaumont area and properties on numerous occasions.
- St Brelade - major flooding of St Aubin's village, harbour and north to La Haule and properties on numerous occasions

4.2 Inland flooding

4.2.1 What is inland flooding

Inland flooding is defined as areas of overland flow and watercourses that cause flooding when water is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. Water will naturally flow to the lowest point, so it is often possible tell where surface water will collect in a flood by looking at the topography of the ground and using that to identify flow paths and watercourses.

Areas of overland flow can be defined as individual catchments. A catchment is the area of land, including the hills, woodlands, and buildings which water drains from, before flowing into watercourses and into the sea. The outside edge of a catchment is always the highest point. Gravity causes all rain and run-off in the catchment to run downhill where it naturally collects in a watercourse. Rain falling outside the edge of one catchment is falling on a different catchment and will flow into other streams and watercourses.

Intense rainstorms and poorly managed overland flow paths and watercourses can mean the potentially destructive power of the water can cause damage to land, property and possibly lives. If overland flow is obstructed, it can act as a dam and cause a build-up of water that, if released, can result in significant consequences.

4.2.2 The role of topography in inland flooding

The topography of Jersey (as shown in Appendix B Figure 1) highlights the areas at the highest elevation are located in the north of the island (approximately 110 to 140 mAOD), There are a noticeable number of narrow valleys which slope from the north, gradually descending to approximately 10 mAOD on the south side of the island adjacent to the sea. Overland flow collects in these valleys and topographic depressions and forms watercourses that flow into the parishes of St Helier, St Lawrence and St Clement, along the coastline.

Flow paths in the east and west of the island are less defined. The highest areas of elevation are located to the north east of the western part of the coastline and the north west of the eastern part of the island. The topography of the western part of the island slopes west with the lower points located along the western coastline. In the east of the island, the land gradually slopes south east, towards Grouville. A number of small watercourses are present in these areas.

4.2.3 Inland flooding in Jersey

The risk of inland flooding has been defined into the following categories:

- High risk of flooding means the area has a chance of flooding corresponding to a 1 in 30 year return period event (3.33% AEP);
- Medium risk of flooding means the area has a chance of flooding corresponding to a 1 in 100 year return period event (1% AEP); and,
- Low risk of flooding means the area has a chance of flooding corresponding to a 1 in 1000 year return period event (0.1% AEP).

Appendix B Figures 4A-4H identify the baseline inland flood risk. The results presented indicate a worst-case scenario and do not include allowance for surface water pumping. There are four surface water pumps located on the south coast which have the potential to reduce flooding. The effects of these pumps have been discussed in Section 4.2.5.

The primary flow paths can be seen conveying the water along natural valley contours toward the south coast. Parts of the coastal plain is at risk of flooding from overspill from St Ouen's Pond and other watercourses in St Ouen's Bay. There is a flow path running north to south crossing the eastern end of Jersey Airport which indicating a low to medium risk of inland flooding. La Rue de L'Eglise/Mont du Jubilé and L'Avenue de Reine Elziabeth II, surrounding the airport, are identified at high risk of flooding. Beaumont in St Aubin's Bay is identified at low risk from inland flooding, however there is also a high risk of ponding on the fields behind La Route de la Haule on Goose Green Marsh and at Sandybrook.

A large area of St Helier is at low to medium risk from inland flooding, where the primary flow paths can be seen converging in the valleys of Grands Vaux and Vallée des Vaux through the lower parts of the town toward the harbour. There are a few isolated areas of existing wetland on the edge of town being at high risk including Rue des Près Marsh adjacent the industrial estate; and at Fountain Lane north of Bagot in St Saviour. There is a small area of ponding identified to the east of Pier Road potentially impacting on buildings on Pier Road; and also to the north-east of the Millennium Town Park.

There is a large flow path of high risk from inland flooding to both fields and houses from Grouville Marsh to Gorey Village, which is held back from the coast by La Rue à Don.

Areas of development that are at risk of flooding in each parish have been discussed in Table 4-4.

Appendix B Figures 4A-4H

Table 4-4 Areas at high risk of flooding from inland flooding

Parish	Areas with existing development which are identified at risk of inland flooding	Corresponding map
St Helier	St Helier town centre	Figure 4G
	Fern Valley/ Bellozanne Valley and First Tower	
	Millbrook	
	Grands Vaux/ Town Mills/ Springfield/ Town Park	
	Vallée des Vaux	
	Queen's Road to Great Union Road	
	Clos du Fort	
	Westmount Quarry	
	Havre des Pas	
St Saviour	Grands Vaux Rue des,Prés/ Plat Douet/ Georgetown Bagot	Figure 4F and 4H
	Havre des Pas	
St Clement	Le Marais	Figure 4G and 4H
	Samarès –Le Squez & Le Marais	
	Le Rocquier/ Le Hocq	
	Pontac	
	Le Bourg	
Grouville	Fauvic Le Bourg/ Les Près/ Gorey Village	Figure 4H
	La Ville-ès-Renauds	
St Martin	Gorey Village North	Figure 4D and 4H
	-Mont des Landes	
	St Catherine's Woods	
	Rozel Valley	
Trinity	Rozel	Figure 4C and 4D
	Bouley Bay	
St John	Le Mourier valley	Figure 4B and 4C

Parish	Areas with existing development which are identified at risk of inland flooding	Corresponding map
St Mary	Le Mourier Valley Grève de Lec	Figure 4A and 4B
St Ouen	Grève de Lecq	Figure 4A and 4E
St Peter	Beaumont Sandbrook	Figure 4E and 4F
St Brelade	St Brelade's Bay St Aubin Some parts of Les Quennevais	Figure 4E and 4F
St Lawrence	Millbrook Bel Royal	Figure 4F and 4G

4.2.4 Reservoirs

Reservoirs in Jersey have a significant influence in the flow of water in the surface water catchments in the island. The island has six raw water reservoirs which fall under the Reservoir (Jersey) Law 1996. Each reservoir has a catchment area, the size of which depends on the geography of the surrounding countryside. Rainfall in a catchment area runs off the land into streams which feed the reservoir. The reservoirs restrict the amount of water flowing down into the lower part of the catchment and, therefore, have a significant impact on the risk of inland flooding downstream of the reservoir location. Water yield for the reservoirs is also supported by other indirect stream water catchments which are pumped to storage in the reservoirs.

Further information on the risk of flooding from reservoirs has been provided in Section 4.3.

4.2.5 Pumping stations

Appendix B Figures 5A-5E identifies the area at risk of inland flooding including the operation of the West of Albert, Samarès Marsh, Baudrette Brook, Bel Royal pumping stations. Further information on these pumping stations is supplied in Section 5.1.2.

The general topography of Jersey promotes overland flow paths towards the south coast, where the four pumping stations assessed are located. A large area in Beaumont and St Aubin's, is identified at low risk of inland flooding, with some areas at high and medium risk. The area to the east of Goose Green Marsh, a designed flood plain, where Bel Royal pumping station extracts water from, has an area at medium risk of inland flooding, whereas to the west of Goose Green Marsh there is a large area at high risk of inland flooding on the marsh, fields and Goose Green car park behind La Route de la Haule. A large area of St Helier is at low risk from inland flooding, with a few isolated areas (particularly highways) identified at medium risk.

Goose Green Marsh experiences a reduced risk of inland flooding when the pumps from Bel Royal are operating, although it should be noted that the Goose Green Marsh outfall to the foreshore is separate to that of the pumped Le Perquage/St Peter's Valley catchment. A large area of St Helier benefits from the pumps at West of Albert operating to extract surface water from the roads and residential areas upstream of the pumping station. For the 1% AEP, the pumps at Baudrette Brook and Samarès Marsh removes surface water from roads, St Clement's Golf Course, Rue des Prés marsh area, and fields behind Clos de la Mare.

Appendix B Figures 5A-5E

4.2.6 Climate change

Climate change is projected to result in more extreme rainfall events which will generate more surface runoff resulting in an increased likelihood of inland flooding. More extreme rainfall can cause the water levels within watercourses to rise rapidly and also increase the pressure on drains and sewers.

As no climate change predictions are specifically available for Jersey, the representation of climate change over time was extracted from values for UK Government peak rainfall intensity allowance in small and urban catchments provided for England[20] and included in Table 4-5. From the below table, the total potential change

[20] Flood risk assessments: climate change allowances, Environment Agency, 2017, available at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances, accessed November 2018

anticipated for the '2080s' for climate change Central uplift percentage of +20% and Upper end uplift of +40% have been used.

Table 4-5 Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Climate Change Scenario	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	+10%	+20%	+40%
Central	+5%	+10%	+20%

The impact of climate change on inland flooding has been defined for the following categories:

- High risk of flooding means the area has a chance of flooding corresponding to a 1 in 30 year return period event (3.33% AEP); including a 20% and 40% uplift to account for climate change;
- Medium risk of flooding means the area has a chance of flooding corresponding to a 1 in 100 year return period event (1% AEP); including a 20% and 40% uplift to account for climate change

Appendix B Figures 6A- 6E identifies the area at risk of inland flooding with the uplift to account for climate change.

The high risk of flooding scenario shows an increased risk of inland flooding in Beaumont. The Goose Green car park and adjacent field are already at high risk of inland flooding and the extent increases into the surrounding fields behind La Route de la Haule for the climate change uplift of 20% and 40%. Inland flooding at Gorey also extends significantly, with the extent being similar for the increased climate change uplift of 20% and 40%.

The medium flood risk scenario indicates that properties in Beaumont are at an increased risk of inland flooding with climate change uplift of 20% and +40%. In addition, a larger area at St Helier is at risk of inland flooding compared to the baseline present day scenario. The increased extent of area at risk from inland flooding is towards the coast affecting the area between the Esplanade and Broad Street. At Gorey, the flow path remains west of La Rue à Don and mostly results in inundation of local fields, however some properties along La Rue à Don and Gouray Village Main Road are at an increased risk of inland flooding.

Appendix B Figures 6A-6E

4.2.7 Historic inland flooding

The Government of Jersey has provided information on historic inland flooding in the island. Records of historic inland flooding are listed in Table 4-6.

Table 4-6 Records of historic inland flooding

Date	Parish	Location	Details
21 May 1983 5 June 1983	St Brelade, St Peter and St Mary	St Aubin, Grève de Lecq and St Peter's Valley	Two severe storms, both bringing over 50mm of rain in one hour in some places. Records show 43mm in one hour at Jersey Airport with a possible 25mm in six minutes. Flooding affected St Aubin, Grève de Lecq and St Peter's Valley[21].
28 February 2010	St Saviour, St Lawrence, St Peter, St Clement, St Helier, St Ouen	Various locations across the Island	Numerous calls to the Fire Service to report flooding to roads, residential properties and gardens and commercial premises.
2014	St Helier & St Saviour	Grands Vaux, Nicholson Close and Pillar Gardens	Road, properties and land flooded. Insufficient capacity of main culvert in valley.
2014	St Peter	Tesson Mill Vallée de St Pierre, Rue du Moulin de Tesson	Road, properties and land flooded. Upstream leat stream overflowed to lower stream and through property.

[21] Severe Storms in Jersey, 31 May and 5 June 1983, David V Randon, Journal of Meteorology, Vol 8, No 84, 1983.

Date	Parish	Location	Details
2014	St Lawrence	Tesson Mews Rue du Moulin de Tesson	Road and properties flooded. Two private pipes restrict flow which then floods properties and road.
2014	St Lawrence	Sandybrook	Road and properties flooded. Water flooded road from above.
2014	St Lawrence	Millbrook House	Road and properties flooded. Flood of water from Parish road.
2014	St Helier	Beresford Street	Road and properties flooded. Failure of penstock gate to open at Weighbridge.
12 June 2015	Unknown	Unknown	Roads flooding in response to heavy rainfall, some areas having over 28mm[22].
8 February 2016	St Helier	Victoria Avenue	Storm Imogen floods roads including Victoria Avenue[23].
16 September 2017	St Ouen and St Peter	Various	Flash flooding in Jersey. Roads left underwater after torrential rain. St Ouen and St Peter badly affected, particularly St Peter's Valley. The road between St Ouen and St Peter was closed and roads below Grève de Lecq hill flooded. The area around St Ouen's Manor also flooded[24].
27 November 2017	St Peter and St Lawrence	Beaumont, St Peter, St Lawrence and Grands Vaux.	Torrential downpours cause flooding. Roads and properties flooded at Beaumont; several inches deep at the bottom of Beaumont Hill. Also flooding in St Peter, St Lawrence and Grands Vaux.[25]
August 2019	St. Peter	La Vallée de St. Pierre	Land flooded caused by a collapsed pipe in a field.
August 2019	St. Peter	Le Vieux Beaumont	Properties flooded. Road gullies blocked causing overflow of surface water into private property.
August 2019	Trinity	La Grande Route de St. Jean	Road and properties flooded. Ponding on water on road surface affecting property.
August 2019	St. John	La Grande Route de St. Jean	Road and properties flooded. Water coming off field to the east flooding road.
August 2019	Trinity	La Route de la Trinité	Road flooded. Blocked private culvert.
August 2019	Trinity	La Route de la Trinité	Blocked private culvert.
August 2019	St. Helier	La Route de la Liberation	No details.
August 2019	St. Peter	Le Mont des Routeurs / Route des Hetres	No details.
August 2019	St. Ouen	La Rue des Cosnets	Road and properties flooded. Road drainage to soakaway. Limited capacity.
August 2019	St. Martin	La Rue d'Aval	Road and properties flooded. Insufficient capacity of road drainage.
August 2019	St. Ouen	La Grande Route de St. Ouen	No details.
September 2019	St. Saviour	Plat Douet Road	Road partially flooded; properties flooded.
October 2019	St. Helier	The Tunnel (Westbound)	Road partially flooded. Gravity sewer under capacity due to build-up of grease. New Pumps and Control Panel at Le Doicq Pumping Station. Heavy and persistent rainfall.
November 2019	St. Lawrence	Mont Félard	Properties flooded. Blocked outlet on private land.

[22] Jersey Evening Post (2015). *St Helier Struck by lightning as thunderstorm and heavy rain batter the island*. Available online at: https://jerseyeveningpost.com/news/2015/06/12/st-helier-home-struck-by-lightening-as-thunderstorm-and-heavy-rain-batterthe-island/
[23] BBC News (2016). *Storm Imogen winds close Channel Island roads and cause flooding*. Available online at: https://www.bbc.co.uk/news/world-europe-jersey-35526934
[24] Jersey Evening Post (2017). *Jersey hit by flash flooding*. Available online at: https://jerseyeveningpost.com/news/2017/09/16/jersey-hit-by-flash-flooding/
[25] Jersey Evening Post (2017). *Jersey hit by flooding*. Available online at: https://jerseyeveningpost.com/news/2017/11/27/jersey-hit-by-flooding/

Date	Parish	Location	Details
November 2019	Grouville	Rue à Don	Road flooded. Outlets to Marsh blocked.
November 2019	Grouville	Rue à Don	Road partially flooded; properties flooded. Gulley at Grouville Church blocked (upstream) leading to downstream gullies becoming surcharged and blocked.
November 2019	St. Clement	La Grande Route de St. Clement	Road partially flooded. Gullies on La Grande Route de St. Clement at junction of Rectory Close blocked and surcharged due to amount of silt coming downhill from Rue du Hocq / La Verte Rue / La Rue Pignon.
November 2019	St. Martin	La Route de Ste. Catherine	Blocked road drainage.
November 2019	Trinity	La Rue de la Monnaie	Property flooded. Insufficient drainage infrastructure of culvert under road.
November 2019	St. John	La Route du Mont Mado	Road flooded; properties flooded. Poor maintenance of culvert and grating of culvert under road.
November 2019	St. Lawrence	La Route de St. Aubin	Capacity of pipe through park, tree roots.
November 2019	St. Brelade	La Rue de la Sergente	Insufficient road drainage.
November 2019	St Peter	Of Route de Beaumont	Blocked culvert flooded properties, field and road junction.
November 2019	St. Peter	Route de Beaumont	Properties flooded. Low lying property pumps out onto road.
December 2019	St. Peter	Rue des Landes	Road flooded. Single Road Gulley blocked with leaves
December 2019	St. Saviour	Rue du Trot	Road flooded. Insufficient capacity of road drainage pipe across fields to the east.
January 2020	St. Helier	La Grande Route de St. Jean	Properties flooded. Single road gulley cannot cope upstream.
February 2020	St. John	Les Chenolles	Properties flooded. Culvert blocked under property. Grating required upstream in field J744.
February 2020	St Peter	Route de l'Aleval	Road flooded. Culvert keeps blocking.
February 2020	St Peter	Vallée de St Pierre	Road flooded. Culvert capacity needs to be reviewed.
March 2020	St Brelade	Route du Sud	Road and property flooded. Gullies becoming blocked; lack of gullies upstream (on Rue des Champs).
March 2020	St Brelade	La Route du Petit Port	Properties and land flooded. Single gulley on downstream side of entrance. Upstream fields have been planted and covered in polythene.
March 2020	St Martin	Le Mont de Rozel / La Vallee de Rozel	Properties flooded. Culvert in parish road and under Le Mont de Rozel full of rubble.
March 2020	St Helier	Vallee des Vaux	Road, land and properties flooded. Culvert getting beaten, overflowing into road and bypassing impounding pond and leat, re-enters downstream of Rossmore into lower stream. Lower stream has also blocked, leading to flooding.
March 2020	St Lawrence	Rue de Haut	Road flooded. Insufficient capacity of private culvert.
March 2020	St Helier	New Road	Properties flooded. Poor maintenance of private culvert.
March 2020	St Clement	Rue de Maupertuis	Properties flooded.
March 2020	St Brelade	Charing Cross	Road and properties flooded. Culvert unable to drain at high tide.
March 2020	St Brelade	Chemin des Pietons	Properties flooded. Culvert becomes blocked.
March 2020	Grouville	Rue Horman	Land and properties flooded. Grating becomes blocked.

Date	Parish	Location	Details
March 2020	St Clement	Vieux Chemin	Road flooded. Parish and private drainage does not have capacity.
March 2020	St Clement	Grande Route de St Clement	Road and property flooded. Water from Rue Laurens enters into property on south side of road.
March 2020	St Clement	Rue du Prebytere	Road flooded. Public drainage becomes blocked with debris.
March 2020	St Saviour	New York Lane	Road and properties flooded. Private culvert to north does not have capacity.
March 2020	St Helier	Wellington Road	Road and properties flooded. Surface water sewer does not have capacity and flows onto St Saviours Road.
March 2020	St Helier	Mont Cochon	Road and properties flooded. Road drainage system does not have capacity.
March 2020	St Ouen	Mont Huelin	Private culvert becomes blocked.
March 2020	St Ouen	Route de Ste Marie	Property flooded. Private culvert becomes blocked. Blocked grating to downstream culvert.
March 2020	St Peter	Avenue de la Reine Elizabeth II	Road flooded. Gullies become blocked flooding primary route.
March 2020	St Peter	Grande Route de St Pierre	Property flooded. Problems with road drainage system.
March 2020	St Peter	La Dimerie	Property flooded. Historic drainage due to blocked culvert.
March 2020	Trinity	Rue de la Fontaine de Colard	Road and properties flooded. Flooding of properties from water off Route d'Ebenezer.
March 2020	Trinity	Rue de la Monnaie	Properties flooded. Insufficient size of downstream culvert.
March 2020	St Brelade	Route de la Moye	Property flooded. Road drainage system does not have capacity.
March 2020	St Saviour	Route de la Hougue Bie	Road flooded. Road drainage becomes blocked.
March 2020	St Martin Grouville	Rue d'Aval	Road flooded. Road drainage becomes choked with mud debris from fields to the east.
March 2020	St Brelade	Route des Genets	Road drainage system through property to small.
March 2020	St Martin	Grande Route de St Martin	Road and property flooded. Private culvert on Rue du Hucquet and road drainage becomes blocked.
March 2020	St Saviour	Route de Maufant	Road and property flooded. Road drainage blocked outlet culvert choked.
March 2020	St Saviour	Route de Maufant	Road flooded. Road drainage blocked.
March 2020	St Lawrence	Waterworks Valley	Road flooded. Road drainage blocked.
March 2020	St Mary	Rue de la Frontiere	Road flooded. Potential issues with capacity of culvert under road.
March 2020	St Mary	Mont de Ste Marie	Road flooded. Potential issues with capacity of culvert under road.
March 2020	St Saviour	St Saviour's Hill	Properties flooded. Capacity of culvert through properties
March 2020	Grouvllle	Route de Grouville	Road and property flooded. Blocked road gullies and downstream culvert.
March 2020	Grouvllle	Route de Grouville	Road and properties flooded. Blocked road gullies and downstream culvert.
March 2020	St Saviour /Grouville	Longueville Road	Road flooded. Blocked road drainage.
March 2020	Grouville	Grande Route des Sablons	Road and property flooded. Insufficient road drainage system through property.
March 2020	St Clement	Rue du Pontietaut	Road and property flooded. Insufficient road drainage floods property lower than road.

Date	Parish	Location	Details
March 2020	St Clement	Grande Route de St Clement	Road, land and property flooded. Main road drainage choked and flooded through school sports hall.
March 2020	St Saviour	Route de la Hougue Bie	Road and properties flooded. Insufficient drainage for water off fields to the north.
March 2020	St Martin	Rue St Julian	Road and properties flooded. Blocked culvert.
March 2020	St Helier & St Saviour	Grands Vaux	Road and properties flooded. Pond requires to be de-silted to increase capacity.
March 2020	St Mary	La Verte Rue	Road and land flooded. Road gully becomes blocked and threatens property.
March 2020	St John	Route du Mont Mado	Road flooded. Gullies and downstream private culvert needs clearing.
March 2020	Trinity	Route d'Ebenezer	Road flooded. Capacity of culvert under road and blocked gullies.
March 2020	Grouville	Route des Cotils	Road flooded. Insufficient road drainage with run-off from Bel Horizon.
March 2020	St Clement	Rue au Long	Road and land flooded.
March 2020	St Brelade	Route de la Baie	Road and properties flooded. Gullies become choked, insufficient road drainage.
March 2020	St Helier	Commercial Street	Basements flooded due to capacities in public sewer.
March 2020	St Helier	Castle Street	Basements flooded due to capacities in public sewer.
March 2020	St Ouen	Grande Route de St Ouen	Road flooded. Water off fields inundates road drainage system.
March 2020	St Lawrence	Route de St Aubin	Property flooded. Insufficient capacity of private culvert under garage.

The Government of Jersey Department for Infrastructure, Housing and Environment has noted a number of observations from historic inland flood events within different areas, as detailed below:

Beaumont – Flooding occurs at the filter-in-turn junction with Route de Beaumont and Route de la Haule. Currently the road drainage system drains to the foul water system, which has limited capacity, and water can pond at the foot of the hill, at the junction. This affects commercial properties as well as private residences.

The removal of road drainage to a separate surface water disposal system will require a pumping station to be built in the area of the Gunsite slipway so that, on high tide levels, storm water can be over-pumped, similar to the pump station on Le Perquage, 200 metres to the east. This would also drain the Goose Green Marsh area and overflow from Le Perquage main stream.

The most recent flooding of this area was in February 2020 when the ‘usual’ properties were flooded, however, the situation was compounded by the blocking of the Beaumont valley culvert that discharges to the foreshore, alongside the Sugar Basin slipway. As a consequence, this event also flooded four properties, opposite the Co-Op Locale store, just to the north of the junction.

Tesson Mill – The main flow of water down St Peter’s Valley, one of the largest catchments in the island, flows along the old leat stream together with a lower natural stream in the bottom of the valley. Flooding occurs at Tesson Mill when the leat stream overtops into the natural stream and flows through a private culvert beneath the mill which surcharges and floods through the floors. Lack of maintenance of the private culvert, possibly a loose granite stone structure, could be a contributing factor. Downstream of the mill, and running alongside the parish road Rue du Mouiln de Tesson, the pen stream in private ownership has been bridged with significantly smaller pipes and this causes both the road, and Tesson Mews, to flood.

Vallée des Vaux – The pen stream that drains this valley has been culverted, just upstream of the Rossmore impounding pond, and flooding occurs in high flows. Debris build-up on the grating for the culvert can also exacerbate flooding, which affects the parish road. When floodwater is diverted from the Rossmore impounding area, it follows the road to the south until it reaches a higher point on the road surface where it discharges into a field north of The Farm and supermarket. The private culvert that drains the natural stream under the supermarket has become blocked in the past which can result in flooding of the supermarket and car park, which is at a lower level.

Home Farm, Rue de Grouville – This sits in a natural bowl of land that drains water to Grouville Marsh further to the east. In the past the lack of maintenance and capacity of the stream culvert under the road has seen water flooding in an east to west direction across the road and into the Home Farm complex, flooding properties. This last happened earlier in 2020. The adjacent Meadowvale Cottage has also been affected in the past.

St Clement – Clos Lempriere and adjacent fields C41 & C42. Water collects in these fields and is unable to drain away other than as ground water and evaporation. Historic flooding of Clos Lempriere estate has occurred on many occasions.

4.3 Reservoir flooding

4.3.1 Overview

The island has six raw water storage reservoirs which are located at:

- Grands Vaux
- Val de la Mare
- Queen's Valley
- Millbrook
- Dannemarche, and
- Handois.

Appendix B Figure 7

The reservoirs store untreated water collected from streams and pumped from raw water abstraction points and the desalination plant. Each reservoir has a catchment area, the size of which depends on the geography of the surrounding countryside. Further description of each of the reservoirs is provided in the following sections.

4.3.2 Reservoir safety

The inspection and maintenance of Jersey Reservoirs falls under the Reservoir (Jersey) Law 1996. In accordance with the law and best practice they are subject to a Section 12 inspection biannually by an appointed Supervising Engineer. Also, under the law, inspection by an independent All Reservoirs Panel Engineer (ARPE) is undertaken every 5 years. Measures to manage the risk of reservoir flooding (infrastructure failure) from the reservoirs in Jersey are implemented by Jersey Water, therefore the risk of flooding is residual.

Each of the Jersey Water reservoirs are classed as either a category 'A' or category 'B' reservoir as described in Table 1 of the Floods and Reservoir Safety 4th Edition (ICE, 2015). Jersey Water has undertaken a flood study for each of the reservoirs to assess compliance with the standard safety check recommended by the guide in respect of sufficient freeboard to accommodate surcharges from floods and wind waves during specific flood events. The results show no significant risk to overtopping the crest; and the capacity of the spillways appears to be adequate at Grands Vaux, Val de la Mare, Queen's Valley, Handois, Dannemarche and Millbrook Reservoirs. Details on each of the reservoirs are discussed below. Further information on the management measures currently in place and mitigation measures that can be implemented is detailed in Sections 5 and 6.

4.3.3 Grands Vaux Reservoir

Grands Vaux Reservoir is situated approximately 2 km northeast of the town of St Helier. It is impounded by a 15 m high concrete gravity dam, which was constructed in 1952. The full supply level of the reservoir is 36.58 m above datum and the capacity is 229,600 m^3. The catchment which feeds the reservoir is mainly open farmland

and woodland and has an area of approximately 9.09 km^2 (see Figure 4-1) The reservoir drains to a small bypass culvert downstream, situated between the dam and the primary school.

The overflow passes over the crest of the central monoliths (i.e. Block Nos. 5–14). The weir is set at 36.58 m OD and is slightly lower over a 30.48 m wide section across the central five blocks. On either side there are 24.38 m sections which are 75 mm higher. The combined width of the weir is 79.25 m. Water passing the weir flows over the downstream face and falls into the concrete channel that runs along the dam toe. The channel drains out into a short stilling basin below Block No.9 and out over a weir into an unlined earth channel. The stream passes down the valley before disappearing into a series of culverts which have largely replaced the natural watercourse on its route through St Helier to the sea.

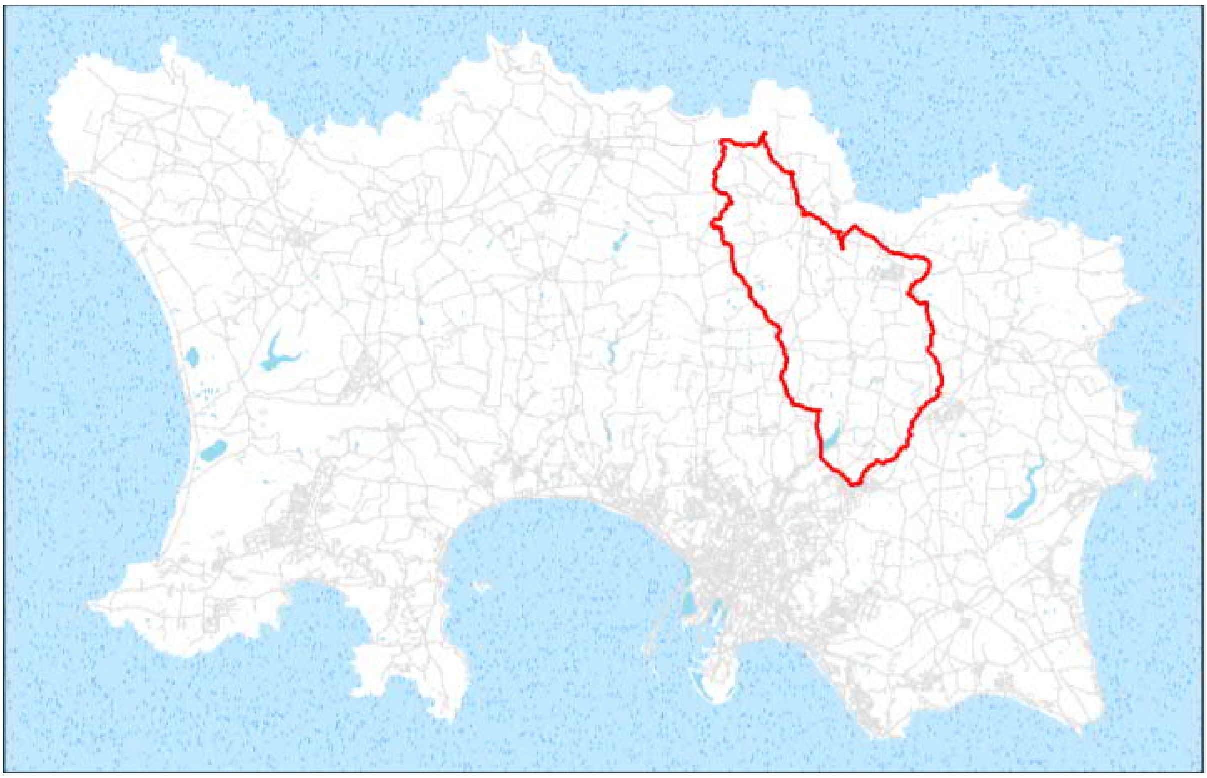

Figure 4-1 Grands Vaux catchment area[24]

Having the largest water catchment in Jersey the Grands Vaux Reservoir is critical to the Jersey Water Supply Infrastructure. It is periodically used to capture and transfer water to Queen's Valley Reservoir and to allow general supply schemes to operate. This means that there is limited capacity in the reservoir to attenuate flood flows generated from significant rainfall within the catchment. ,

The Grands Vaux Reservoir basin is small and can fill very rapidly during a storm. The flood volume, in severe weather, can be greater than the capacity of the basin and, in combination with the steep topography of the land around the reservoir, the reservoir frequently overflows as it is designed to do. The topography of the area immediately downstream of the dam consists of a steep sided, narrow valley which channels any overtopped water down the valley into St Helier. As a control measure, the downstream (school) bypass culvert is continuously monitored for level and blockages by Jersey Water's 24 hour control room. The existing drainage network in St Helier can accommodate low return period events like the 1 in 1 year (100% AEP) but would be unable to handle events of greater magnitude (lower AEP)[26].

Modelling of the Grands Vaux Reservoir indicates that a 1 in 100 year (0.1% AEP) return period rainfall event, with more than 53mm of rain within a 6 hour duration, could have significant effects on the area downstream. The latest States of Jersey Grands Vaux Flood Plan[27] was updated in July 2018 and contains details of the multi-agency response to flooding due to an extreme storm event resulting in an increase of water in the catchment and subsequent reservoir overflow. The flood plan details the triggers and activation process of the plan if a

[26] Report on Grands Vaux Catchment and Flood Protection Measures (States of Jersey, June 2000)
[27] Grand Vaux Flood Plan (2018). Available online from: https://www.gov.je/SiteCollectionDocuments/Staying%20safe/SoJ%20Grand%20Vaux%20Flood%20Plan%20v2.1.pdf

forecasted or un-forecasted flood event was to occur. The flood plan also shows the area at risk of flooding if the reservoir was to overflow during an extreme storm event.

It should be noted that a review of the treatment of reservoirs within a planning policy context has been undertaken to understand how the risks associated with the overflow of the Grands Vaux Reservoir during more extreme storm events might be considered within the Island Plan Review. This is of particular interest for Government of Jersey as St Helier is the primary urban centre in the island and may be the focus for growth within the Plan Review period.

4.3.4 Val de la Mare Reservoir

Val de la Mare Reservoir[28] is situated in the Parishes of St Peter and St Ouen with a direct catchment area of 3.28 km^2. The reservoir was formed by the construction of a 29 m high concrete gravity dam across the mouth of the Val de la Mare valley. It has a maximum depth of about 20 m and a capacity of 0.94 Mm3. The surface area at the full supply level of 46.02 m OD is about 105,000 m^2. The dam comprises 27 No. mass concrete monoliths, each of which is 6.7 m wide. The upstream face of each monolith is vertical while the downstream face is sloped.

The overflow passes over the crest of the central monoliths (i.e. Blocks 12-14) with the weir set at 46.02 m OD. The weir is set slightly higher at 46.1 m OD over the adjacent monoliths (i.e. Blocks 8-11 and 15-18). Overflowing water passes down the downstream face of the dam and into a collection channel along the toe from which it passes into a concrete channel that drains into a 36-inch diameter pipe that continues below the valley floor and eventually emerges into the natural watercourse downstream of the road, La Route du Moulin.

4.3.5 Queen's Valley Reservoir

Queen's Valley Reservoir[29] is situated in the parishes of Grouville and St Martin with a direct catchment area of 5 km^2. There are three dams in cascade: the main dam, the intermediate dam and the silt pond dam. The reservoir was formed by construction of a 35 m high rockfill dam with a central dense bituminous concrete core, it has a maximum water depth of 21 m and a capacity of 1,190 Mm^3. The surface area at the full supply level of 36 m OD is about 77,000 m^2. The crest is approximately 5.5 m wide with a crest height of 38.6 m OD at the centre of the dam dropping to 38.1 m OD at the abutments. The crest has a wave wall that extends 900 mm above the crest, and at its lowest point is 39 m OD. The top of the bituminous core is 500 mm below crest level, 37.6 m OD at the abutments. The upstream slope is protected against wave erosion by rip-rap down to 25 m OD, with rockfill exposed below this level.

The overflow structure is a circular ogee weir on a bellmouth, at a level of 36 m OD and 11.8 m in diameter. The weir encircles the shaft and discharges down a segment of the shaft on its downstream side. The shaft enters the overflow and access tunnel through a throttled section of tunnel, 1.6 m high at the upstream end and 0.8 m high at the downstream end where it discharges into a 2.1 m high tunnel. The tunnel has an overall diameter of 3.0 m, the bottom segment of which is filled in to accommodate the draw-off and scour pipes. The invert of the tunnel at the upstream end is 12.8 m OD and it is approximately 140 m long. At the downstream end it opens into a covered stilling basin where a jump forms to reduce velocity to sub-critical. Downstream of the stilling basin, there is an outlet pond leading to an outlet stream that eventually discharges into the sea near Gorey.

4.3.6 Handois, Dannemarche and Millbrook Reservoirs

Handois, Dannemarche and Millbrook Reservoirs[30] are all located in the Parish of St Lawrence within Waterworks Valley. The three reservoirs form a cascade starting with Handois at the upstream end, then Dannemarche and finally Millbrook Reservoir. Handois is located to the north of the valley and Millbrook at the south.

Handois Reservoir was formed by construction of a 7 m high concrete gravity dam. The reservoir has a capacity of 187,000 m3. The surface area at the full supply level of 88.69 m OD is 31,700 m^2. The dam has a crest level of 90.88 m OD and stands approximately 7 m above existing ground level. There are two overflow structures, an original spillway that was built into the dam near the left abutment and an auxiliary spillway that was cut into the left flank and passes around the west side of the dam. The modified original spillway has a 6.1 m long weir set at the full supply level of 88.69 m OD. This discharges down a stepped masonry channel to the toe before passing

[28] Val de la Mare reservoir Flood Study (2018)
[29] Queens Valley Reservoir Flood Study (2018)
[30] Waterworks Valley Cascade Flood Study (2018)

around the Treatment Works in a series of channels and culverts on its way back to the natural watercourse downstream. The total catchment area is 2.71 km2. The catchment is predominantly rural and the land is mainly given over to mixed farmland and woodland.

Dannemarche Reservoir was formed by construction of an 8 m high, masonry gravity dam. The impounding reservoir has a capacity of 93,000 m^3. The surface area at the full supply level of 46.02 m OD is 20,200 m^2. Reservoir construction was completed in 1909. Dannemarche dam is a masonry faced concrete gravity dam with a nominal crest level of 47.199 m OD. There are three overflows, two of which are located at the left abutment and the third is at the right abutment. The one at the left abutment is the original spillway and is now referred to as the emergency spillway. The total catchment area is 4.71 km2, of which 2.00 km2 drains directly to the reservoir, while the remaining 2.71 km2 is routed through Handois Reservoir upstream. The additional catchment area between Handois and Dannemarche reservoirs has similar characteristics to the Handois catchment.

Millbrook Reservoir was formed by construction of a 6 m high dam. The impounding reservoir has a capacity of 36,000 m^3. The surface area at the full supply level of 19.84 m OD is 15,700 m^2. Millbrook Dam has a masonry mass concrete wall that is backed by puddle clay and supported by an earthfill embankment on the downstream side. It has a nominal crest level of 20.71 m OD and a maximum height of 6 m. There are three overflow spillways. The original spillway is located at the left abutment and passes around the east of the dam. It is 9.4 m long and is an 'L' shaped weir set at 19.84 m OD. The weir discharges into a narrow tumble bay where it is joined by the bywash channel, which flows around the left side of the reservoir. The channel cascades down the left abutment to the valley bottom. Two auxiliary spillways are located on either side of the valve tower. Each has a 10 m long weir set at 20.55 m OD. The weirs discharge down stepped chutes and over the car park. The total catchment area is 5.98 km2, of which 1.27 km2 drains directly to the reservoir. The remaining area is routed at varying degrees through Handois and Dannemarche upstream. The additional catchment area has similar characteristics to that of Handois and Dannemarche upstream.

The flood study undertaken for the Waterworks Valley reservoirs found that as the auxiliary spillways at Millbrook do not discharge into a channel, any flood event in which these spillways come into use could result in flooding downstream of the reservoir. The study found that the original spillway can pass the flows from up to a 1 in 500 year event before reservoir water levels rise to auxiliary spillway weir level. Flood inundation mapping for Millbrook Reservoir[31] identify the areas that could become inundated downstream during significant flood events which result in the auxiliary spillway weir level being reached. Whilst it was found that the risk is within the range of tolerability it could be beneficial to develop a suitable emergency plan to provide warning to residents/owners in the event of severe flooding.

4.3.7 Historic Flooding

The Government of Jersey Department for Infrastructure, Housing and Environment has identified that the Grands Vaux area, in particular around Nicholson Close and Pillar Gardens, is a known area for flooding. The estates have been flooded on several occasions over the last ten years, including 28th February 2010. The cause is linked to the intensity of the storm, overflow from the reservoir, and capacity with the downstream drainage infrastructure The flooding is caused by a designed overflow coming into operation when the upstream flow in the 1500mm pipe that bypasses Grand Vaux Primary School reaches an 'open' chamber with a restricted discharge to the downstream 1140mm sewer. The level of water rises in the 'open' manhole and discharges onto Grands Vaux road, the designed overflow. The flood travels down the road entering properties on the lower east side before reaching the low point in the road at the entrance to Nicholson Close and Pillar Gardens. Parish road drainage along the route is unable to drain the flow of water. The water then floods into the low-lying area of the estates and enters properties.

4.4 Sewer Flooding

The Government of Jersey flooding hotspots data has been used to identify areas which may have previously experienced sewer flooding. Table 4-7Table 4-7 identifies the areas which may have experienced sewer flooding. It should be noted that this data is currently being updated by the Government of Jersey and is subject to revision.

Table 4-7 Flooding Hotspots

Parish	Location of flooding hotspot	Number of flooding hotspots

[31] Inundation Mapping and Quantitative Risk Assessment: Millbrook Reservoir (2019)

St Helier	St Helier	8
St Clement	La Grève D'Azette	1
	Pontac	1
St Lawrence	Millbrook	1
	First Tower	1
St Peter	Beaumont	3
St Brelade	St Aubin	1
St Ouen	L'Étacq	1
Trinity	La Ville à L'Évêque	1
St Martin	Rozel Bay	1

4.5 Summary

The SFRA provides background information to ensure that the materiality of flood risk is considered as part of the assessment of spatial options for the Island Plan Review and for the assessment of individual sites. The assessment of flood risk in this chapter leads to the conclusion that careful consideration of local flood risk is required in some of the island's urban areas, including those in the parishes of St Helier, St Lawrence, St Peter, St Brelade, Grouville and St Martin, where most existing development is located, and where new development could be located in in the future.

To help mitigate the risk of flooding in Jersey, a number of mitigation and management measures are currently in place which reduce the risk of flooding from different sources. Information on these mitigation measures is provided in Section 5. The standard of protection and residual risk of flooding from these mitigation measures should be considered when assessing the potential risk of flooding to any new developments.

5. Flood risk mitigation measures in Jersey

5.1 Current flood risk management measures

5.1.1 Coastal flooding

There are extensive man-made coastal defences present around parts of the island's coastline. The defences are generally in a good condition; however, some are not to a high specification and, therefore, there is a risk they may not withstand increased water depths as a result of climate change. Further information on the main flood defences assets located in each parish is provided below in Table 5-1 and mapped in Appendix B Figure 8.

Table 5-1 Coastal Flood Defences

Parish	Location	Flood Defence Type	Condition	Potential risk of flooding from the 1 in 200 year flood levels[32]	Associated Map
St Helier	Bellozanne	Sea Wall	2- Good	Defence higher than still water level tide	Figure 8F and 8G
	St Helier	Structure	1- Very good	Still water level tide exceeds existing defence height but is lower than surrounding ground level	
		Stonework structure	3- Fair	Still water level tide exceeds existing defence height	
		Sea Wall	2- Good	Still water level tide exceeds existing defence height	
		Structure	2- Good	Defence higher than still water level tide	
St Saviour		Structure	2- Good	Defence higher than still water level tide	Figure 8H
St Clement	Le Squez	Wall	2- Good	Still water level tide exceeds existing defence height	Figure 8G and 8H
		Structure	1- Very good	Defence higher than still water level tide	
	Samarès	Wall and Revetment	2- Good	Defence higher than still water level tide	
		Revetment	2- Good	Defence higher than still water level tide	
	Le Haguais	Wall	2- Good	Still water level tide exceeds existing defence height but is lower than surrounding ground level	
	Le Hocq	Revetment	1- Very good	Defence higher than still water level tide	
		Wall	2- Good	Still water level tide exceeds existing defence height but is lower than surrounding ground level	
	Pontac	Revetment	2- Good	Still water level tide exceeds existing defence height	
	Le Bourg	Wall and Revetment	2- Good	Defence higher than still water level tide	
		Wall	2- Good	Defence higher than still water level tide	

[32] See Appendix B Figure 9

Parish	Location	Flood Defence Type	Condition	Potential risk of flooding from the 1 in 200 year flood levels[32]	Associated Map
Grouville	La Rocque	Wall	2- Good	Defence higher than still water level tide	Figure 8H
		Slope	2- Good	Defence higher than still water level tide	
	Le Hurel	Revetment	2- Good	Still water level tide exceeds existing defence height but is lower than surrounding ground level	
		Rock/Shingle	2- Good	Defence higher than still water level tide	
	Fauvic, La Ville-ès-Renauds, Gorey,	Wall	2- Good	Defence higher than still water level tide	
St Martin	Faldouët	Wall	2- Good	Defence higher than still water level tide	Figure 8D and 8H
	Archirondel	Wall	2- Good	Defence higher than still water level tide	
	Fliquet	Revetment and Wall	2- Good	Defence higher than still water level tide	
	Fliquet	Wall	2- Good	Defence higher than still water level tide	
Trinity	Bouley Bay	Wall	2- Good	Defence higher than still water level tide	Figure 8C and 8D
St John	Mont Mado	Wall	2- Good	Defence higher than still water level tide	Figure 8B and 8C
St Ouen	La Grève de Lecq	Wall	2- Good	Defence higher than still water level tide	Figure 8A and 8E
	L'Étacq	Revetment	2- Good	Defence higher than still water level tide	
	Les Mielles Nature Reserve	Wall	1- Very good to 3- Fair	Defence higher than still water level tide	
St Peter	Les Mielles Nature Reserve	Wall and Rock Armour	2- Good	Defence higher than still water level tide	Figure 8E and 8F
St Brelade	Le Port	Wall	2- Good	Defence higher than still water level tide	Figure 8E and 8F
	Le Braye	Revetment and Wall	2- Good	Defence higher than still water level tide	
		Wall	2- Good	Defence higher than still water level tide	
	Ouaisné Bay	Wall	1- Very good to 3- Fair	Defence higher than still water level tide	
St Lawrence	La Haule	Wall and Revetment	2- Good	Defence higher than still water level tide	Figure 8F and 8G
	Beaumont	Wall	1- Very good to 2- Good	Defence higher than still water level tide	

Appendix B Figures 8 and 8A-8H

Appendix B Figure 9

The preferred policies to manage the risk of coastal flooding and an associated action plan for implementation are detailed in the Jersey Shoreline Management Plan (as discussed in Section 5.2.1).

5.1.2 Inland flooding

Six pumping stations are present in the island, as illustrated in Figure 5-1, and they pump surface water from the drainage network into the sea. Each pumping station drains a different catchment area and varies in the rate of pumping. The catchment areas for the Baudrette, Bel Royal, Samarès Marsh and West of Albert pumping stations are illustrated in Appendix C.

Bel Royal pumping station pumps Le Perquage stream and does not protect Beaumont. West of Albert pumping station drains the central and eastern areas of St Helier, but not the western areas – West Park, Rouge Bouillon, Queen's Road areas. The Underpass pumping station only drains a low lying road.

As discussed in Section 4.2.5, the pumping stations reduce the severity of inland flooding in a number of locations (as mapped in Appendix B Figures 5A-5H).

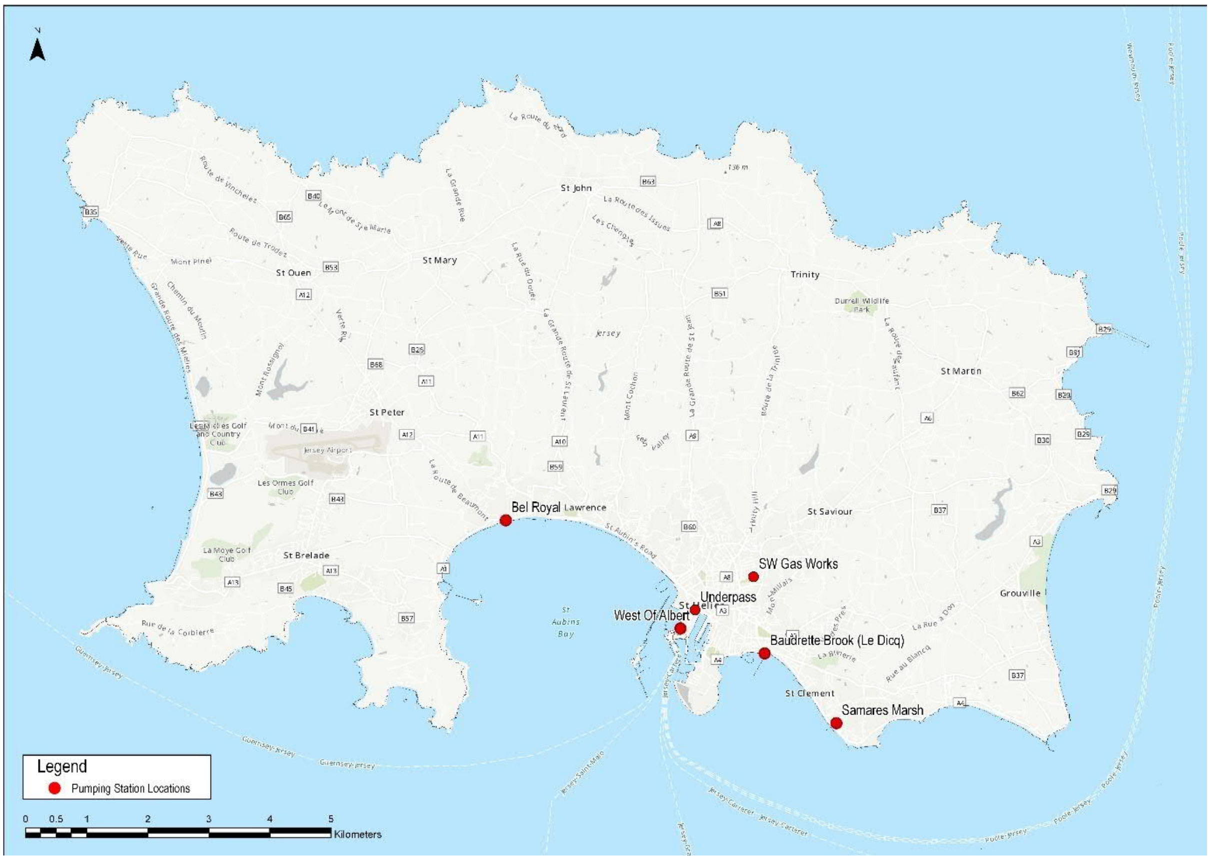

Figure 5-1 Pumping station locations

There are also a number of water impounding areas which provide storage of water across the island. Further information on the water impounding areas located in each parish is provided below in Table 5-2 and mapped in Appendix B Figure 8 and 8A-8H.

Table 5-2 Water Impounding Areas

Parish	Location	Type of structure
St Mary	Fields MY957A & MY973 off Rue de la Vallee	Restricted outlet chamber
St Peter	Fields P786, P787 & P788 north of The Mermaid	Earth bund with restricted discharge and overspill
St Brelade	Field P303 to the north of Clos Saut Falluet	Earth bund with restricted discharge and overspill
St Brelade	Creepy Valley (flood plain)	Discharge to valley floor
St Brelade	Field B224 Pont Marquet Country Park	Concrete dam with overspill
St Brelade	Field B771 Railway Walk off Mont les Vaux	Open outlet no restriction

Parish	Location	Type of structure
St Lawrence	Fields L861, L862, L862A and L863 (flood plain)	Stream overflow to fields
St Helier	Rossmore Farm, Vallee des Vaux	Granite wall/earth bund with
St Helier	Grands Vaux Pond, Grands Vaux	Concrete dam with limited discharge and overspill
St Saviour	Field S620 Government House, St Saviour's Hill	Earth bund with restricted discharge and overspill
St Saviour	Fields S846 & S847 Fountain Lane	Earth bund with restricted discharge and overspill
St Saviour	Field S765 Longueville Manor – Swiss Valley	Earth bund with restricted discharge and overspill
St Saviour	Fields S27, S28 AND S29 Rue des Pres Trading Estate	Earth bund with restricted discharge and overspill & control gate
St Saviour	La Becquetterie (Scout Hall) Rue des Pres	Concrete channel with overspill
St Clement	Field C3, La Blinerie	Earth bund with raised outlet
St Clement	Le Petit Marais, Le Marais	Earth bund with raised outlet
St Clement	Le Hocq Marsh, South of Le Rocquier School	Earth bund with restricted discharge
Grouville	Field G146 Grouville Marsh, off Rue Horman	Concrete control gate structure
Grouville	The Willows (Jersey Potteries) off Rue Horman	Earth bund with raised outlet

Appendix B Figure 8 and 8A-8H

5.1.3 Reservoir flooding

In Jersey a number of the catchment areas generate more water than can be stored in the respective reservoir. To overcome this problem and fully utilise the reservoir and catchment area capacity, a partial system of raw water transfer mains has been developed which, in some cases, allows water to be moved between the reservoirs. The pumped stream abstraction points can be controlled and are not used when the reservoirs are full. A summary of the Jersey Water supply network is illustrated in Figure 5-2.

When full, the reservoirs hold enough useable water to provide approximately 120 days of supply to the Island. Reservoirs are equipped with monitoring equipment allowing water levels and certain quality parameters to be continuously monitored. When required for treatment, the stored water is pumped from the reservoirs to either Handois or Augrès Water Treatment Plants.

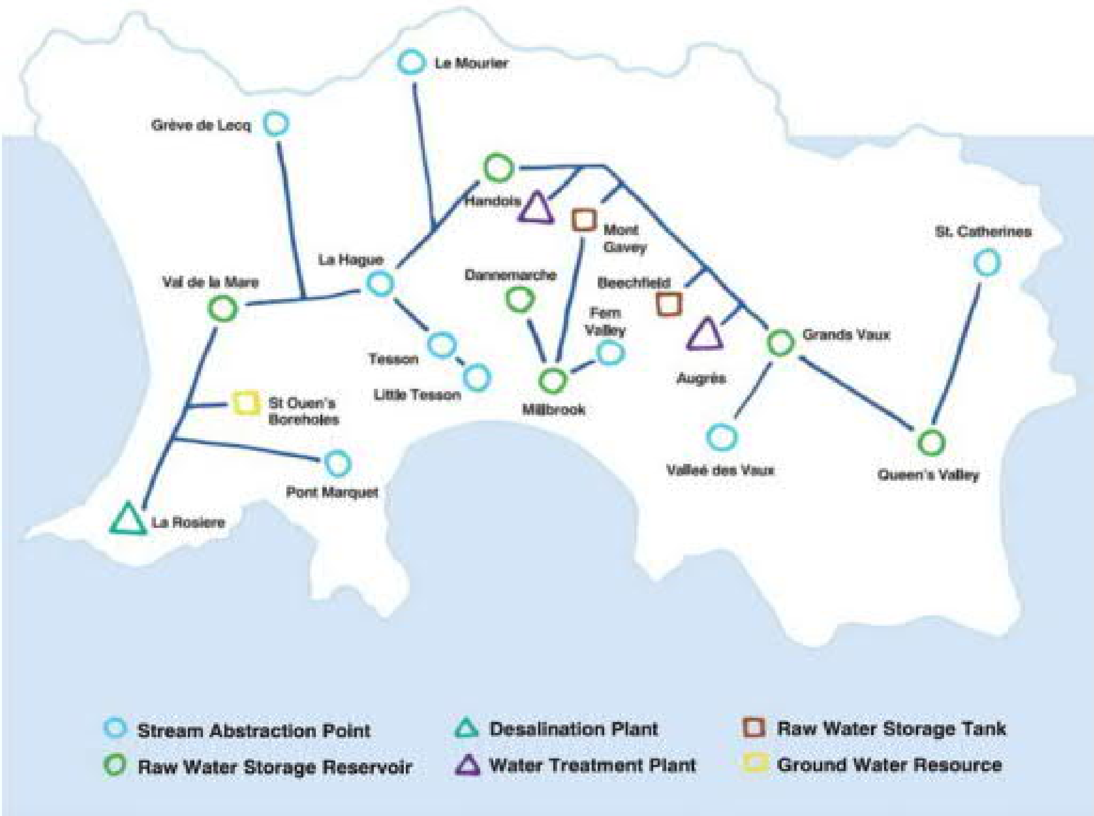

Figure 5-2 Jersey Water Supply Schematic (Jersey Water, 2019)[33]

5.2 Future flood risk management measures

5.2.1 Coastal flooding

The Jersey SMP provides an island-wide assessment of the risks associated with flooding and erosion from coastal sources. It sets out a framework to manage these risks to the community, environment and economy of Jersey in a sustainable manner over the next 100 years (up to 2120).

The SMP details the management intent for the island's coastline over the next 100 years (up to 2120). The aim is to prevent and manage the effects of coastal erosion and flooding. The impact of climate change on rising sea levels over time has been assessed. The plan considers risks to the community, environment and economy of Jersey. It takes into account the coastal defences that are in place around the island.

A summary of the Shoreline Management Plan (SMP) and its policies is provided below.

5.2.1.1 Jersey Shoreline Management Plan

The Jersey SMP considers risks to the community, environment and economy of Jersey. The plan considers the coastal defences that are around the island and identified where improvements may be needed. Three time periods were considered as part of the assessment (Present day (2020-2040), Medium Term (2040-2070) and Long Term (2070-2120)) and mitigation options for each of these scenarios was proposed.

To assess the best option for the different parts of the coastline, the coastline was divided into smaller units. The coastline was divided into six Coastal Management Areas (CMAs). Each CMA has similar risks of flooding, coastal erosion and levels of development. These CMAs were further subdivided into 36 Coastal Management Units (CMUs). The policy options were set at the CMU level so that the management intent is appropriate at a local scale. Figure 5-3 shows the location of each CMU.

[33] Taken from Jersey Water's website- https://www.jerseywater.je/

Four management policies were considered for implementation within the SMP, which include:

- No Active Intervention – a policy decision to not invest in coastal defences or maintenance work. The shoreline is left to naturally evolve without intervention. This policy generally applies to natural areas of the coastline which are currently undefended;
- Maintain the Defence Line – existing coastal defences are maintained. The level of flood protection may decrease in some locations over time due to climate change. This policy generally applies where the existing defences provide a reasonable standard of flood protection or prevent erosion of the shoreline;
- Adaptive Management – a policy to proactively manage and mitigate coastal flood or erosion risk. The policy will be delivered through various management schemes / initiatives depending on the level of risk and the circumstances. This could include improving the standard of flood protection for an existing sea defence, constructing new defences, raising awareness of local flood risk or recommending property level flood protection; and,
- Advance the Line – new sea defences are built seaward of existing defences. This policy will only be implemented in areas where there is a significant risk of coastal flooding or erosion, or where it will deliver additional benefits for the community, environment and economy, such as creating a new amenity space.

A summary of the policy options for each policy area is shown in Table 5-3.

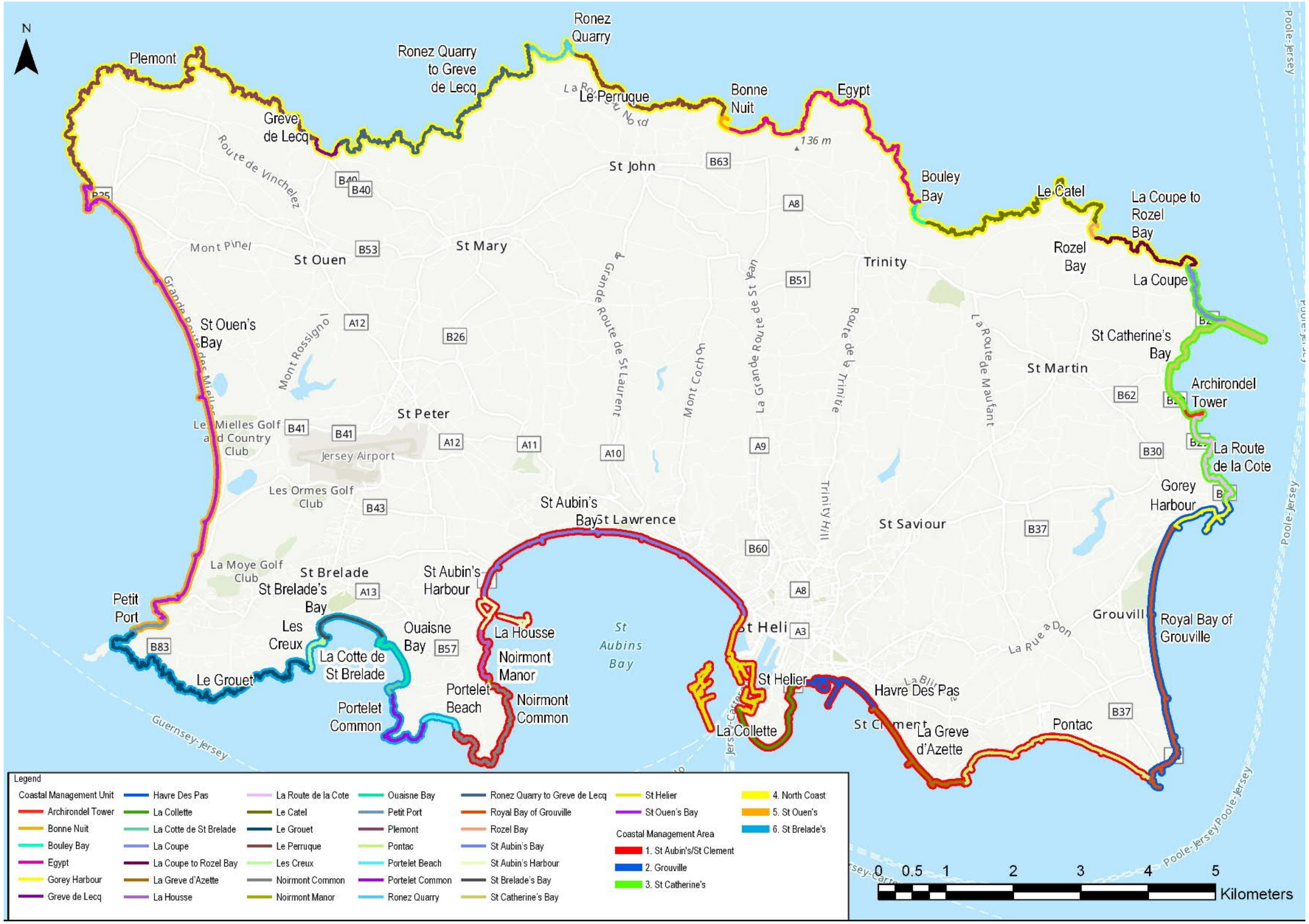

Figure 5-3 Coastal Management Unit locations, Jersey Shoreline Management Plan

Table 5-3 Policy Recommendations from the SMP

KEY:
NAI: No Active Intervention
MTDL: Maintain the Defence Line
AM: Adaptive Management
ATL: Advance the Line

		Present day 2020-2040	Medium term 2040-2070	Long term 2070-2120		
1.1	Noirmont Common	NAI	NAI	NAI	✗	✓
1.2	Belcroute Bay	MTDL	MTDL	MTDL	✗	✓
1.3	La Housse	NAI	NAI	NAI	✗	✓
1.4	St Aubin's Harbour	AM	AM / ATL	MTDL	✓	✗
1.5	St Aubin's Bay	AM	AM / ATL	MTDL	✓	✗
1.6	St Helier	MTDL	AM	MTDL	✓	✗
1.7	La Collette	MTDL	MTDL	MTDL	✗	✗
1.8	Havre des Pas	AM / ATL	MTDL	MTDL	✓	✗
1.9	La Grève d'Azette	AM	AM	MTDL	✓	✓
1.10	Le Hocq / Pontac	AM	AM	MTDL	✓	✓
2.1	Royal Bay of Grouville	AM	AM	MTDL	✓	✗
2.2	Gorey Harbour	MTDL	AM	MTDL	✓	✓
3.1	La Route de la Cote	MTDL	MTDL	MTDL	✓	✓
3.2	Archirondel Tower	AM	MTDL	MTDL	✓	✗
3.3	St Catherine's Bay	MTDL	MTDL	MTDL	✓	✗
3.4	La Coupe	MTDL	MTDL	MTDL	✗	✓
4.1	La Coupe to Rozel Bay	NAI	NAI	NAI	✗	✗
4.2	Rozel Bay	MTDL	MTDL	MTDL	✓	✗
4.3	Le Catel	NAI	NAI	NAI	✗	✗
4.4	Bouley Bay	MTDL	MTDL	MTDL	✓	✗
4.5	Egypt	NAI	NAI	NAI	✗	✓
4.6	Bonne Nuit	MTDL	MTDL	MTDL	✓	✓
4.7	La Perruque	NAI	NAI	NAI	✗	✗
4.8	Ronez Quarry	NAI	NAI	NAI	✗	✗
4.9	Crabbé	NAI	NAI	NAI	✗	✗
4.10	Grève de Lecq	MTDL	MTDL	MTDL	✓	✗
4.11	Plemont	NAI	NAI	NAI	✗	✗
5.1	St Ouen's Bay	MTDL	MTDL	MTDL	✓	✗
5.2	Petit Port	MTDL	MTDL	MTDL	✗	✗
6.1	Gorselands	NAI	NAI	NAI	✗	✓
6.2	Les Creux	NAI	NAI	NAI	✗	✓
6.3	St Brelade's Bay	AM	AM	MTDL	✓	✓
6.4	Ouaisne Bay	MTDL	MTDL	MTDL	✓	✗
6.5	La Cotte de St Brelade	NAI	NAI	NAI	✗	✓
6.6	Portelet Common	NAI	NAI	NAI	✗	✓
6.7	Portelet Beach	NAI	NAI	NAI	✗	✓

5.2.2 Inland flooding

The Government of Jersey Department for Infrastructure, Housing and Environment has identified that there are no immediate plans for future inland attenuation schemes as an overarching inland flooding strategy for the island has yet to be developed to help identify the priority areas requiring intervention.

5.2.3 Sewer flooding

5.2.3.1 Waste Water Strategy

In March 2014, the Government of Jersey published its Waste Water Strategy[34] outlining plans for the next 20 years. The strategy focuses on the need to replace the sewage treatment works (STW) at Bellozanne and the deterioration of the sewers and drains that collect and transport sewage to Bellozanne STW and present a risk of flooding.

To address these issues, the Waste Water Strategy provides a prioritised and sustainable plan for improvement works over the 20 year period of the strategy.

The Strategy also looks at the sewerage network (the sewers and drains that collect and transport sewage to Bellozanne STW for treatment and surface water to the sea). In order, the priorities are:

1. to repair and refurbish the sewerage network
2. to continue to undertake projects to install new drains so that the surface water is separated from the sewage. This reduces the amount of water that does not require costly treatment, going to Bellozanne STW, and allowing it to go straight to sea
3. to connect appropriate properties to the network that currently have no connection

5.2.3.2 Jersey Sewerage Assessment

In 2014, Grontmij were commissioned by the Government of Jersey to update a sewer network model for the island to identify any areas that required maintenance and upgrade works. The following issues were identified in the study:

- Pollution and eutrophication in St. Aubin's Bay from waste water treatment works discharges.
- Issues with various combined sewer overflow discharges.
- Concern over the potential impact on Ramsar sites and oyster beds.

Flooding has been reported in the town centre of St Helier, surface water flooding is known to occur intermittently in the St Aubin's / Charing Cross area and flooding also occurs at Gunsite Tower (flooding in the marsh area) near Beaumont Sewage Pumping Station (SPS).

[34] Government of Jersey (2014), *Waste Water Strategy*. Available online at: https://www.gov.je/News/2014/Pages/WasteWaterStrategy.aspx

6. Strategic flood risk management

This Section identifies strategic flood management options which could be used to help reduce the risk of inland flooding in Jersey.

6.1 Flood storage areas

Flood storage areas (FSA) aim to reduce the flows passed downstream in watercourses to mitigate flooding further along in the catchment. Flood storage areas are designed to detain runoff or flow within a watercourse, releasing it downstream at a slower rate. There are two types of water storage:

Offline storage

Offline storage is where water is diverted from the watercourse, stored in a separate area which may still be part of the floodplain, then later released back to the watercourse (Figure 6-1). An inflow structure, such as a weir, diverts water to the storage area when the watercourse level exceeds a predetermined value, and the outlet structure returns the water to the watercourse after the flood peak has passed, either via gravity, pump or both.

Online storage

Online storage is where water is temporarily stored within a watercourse channel and floodplain, usually behind a dam or impoundment structure (Figure 6-1). The flow control structures such as pipes, flumes or sometimes gates, are normally located inside the impoundment structure and control the outflow of water from the storage area back into the channel.

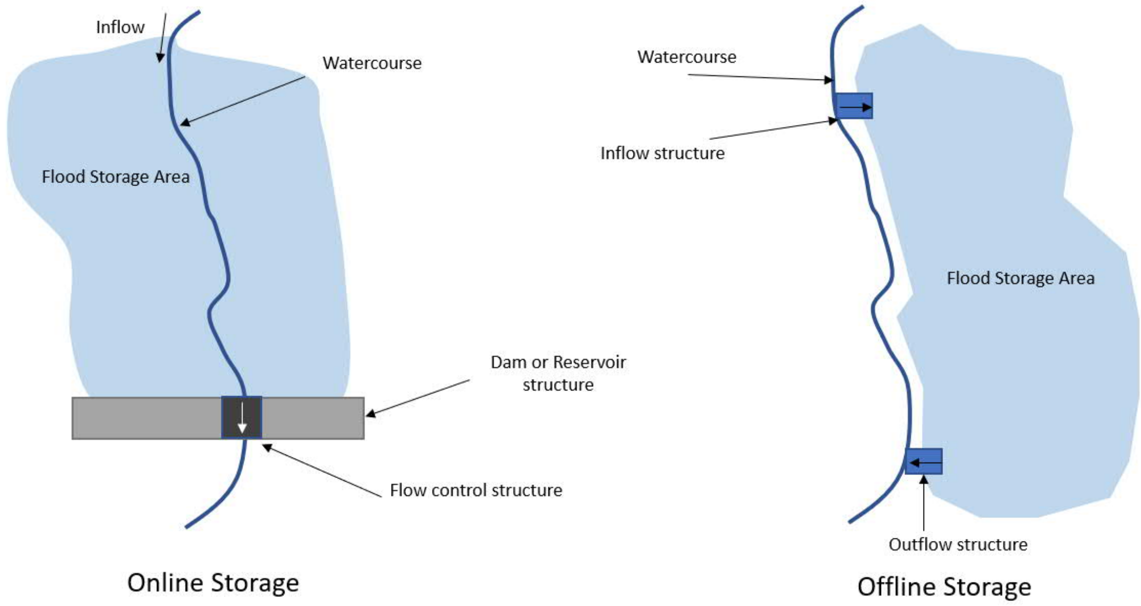

Figure 6-1 Online and Offline Flood Storage Areas

FSAs along watercourses work by removing a volume of water from the watercourse at high flows thereby reducing the flow of water downstream. To work efficiently, the FSAs need to be designed such that they remove the high flood flows. If an FSA is at capacity before the peak flow arrives, it will have a negligible impact on reducing flood level rise downstream and therefore be ineffective.

Impounding FSAs, also known as online FSAs, are constructed across watercourses and restrict the peak size of downstream flows along the watercourse. Impoundment is usually achieved through construction of a dam and flows are restricted by means of a culvert (or pipe). The culvert may be fitted with a flow control device to better control the magnitude of the flows passing through.

On impounding reservoirs, the size of the culvert passing through the dam is critical. If the culvert in the dam is too large it will allow too much water to pass through and thereby not achieve the required standard of protection downstream. If the culvert through the dam is too small, it will start restricting the flow of water too early and the FSA will be full before the peak flows have occurred. The design of culvert size is further complicated because the amount of water passing through the culvert will vary with varying depths of water retained in the FSA. This problem may be overcome through the use of a vortex flow control device.

Non-impounding FSAs, also known as offline FSAs, are not constructed across a watercourse but are located next to them. Typically, non-impounding FSAs comprise an inlet structure, a dam or retaining structure and an outlet structure. Peak water flows are removed from the watercourse, are stored temporarily, and then are returned once the peak flows have passed.

The inlet structures to non-impounding FSAs can take many different forms including weirs or culverts and channels, both of which may have control gates. In the case of inlet weirs or inlet channels, the inlet level needs to be set such that the storage area starts to fill thus removing the peak of the flood flow from the river system. Where inlets are gated, the gate needs to open once the river has reached a pre-defined level.

Outlets from non-impounding FSAs can either be via gravity through an open or gated culvert. The gravity outlet commences operation once the peak river flow has passed and requires no manual intervention. The gravity outlet ensures that the FSA commences emptying as soon as possible after a flood event and so is ready for re-use should there be another flood in the watercourse. In contrast, gated outlets require manual intervention and the FSAs will remain full until the gate is opened. FSAs vary considerably in size, shape and nature. They can be relatively simple having only one inlet and outlet or they can be more complex with multiple inlet and outlets.

The type of FSA suitable for a particular location depends on a number of factors. In general, however, where high watercourse levels occur over a long period, it is more efficient to use a non-impounding FSA. Where watercourse levels rise and fall quickly, it is better to use an impounding FSA.

6.2 Catchment and floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, and by creating space for naturally functioning floodplains working with natural processes. Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures are methods that could be implemented to help catchment and floodplain restoration:

- Promoting existing and future brownfield sites, that are adjacent to watercourses, to naturalise banks as much as possible.
- Buffer areas around watercourses provide an opportunity to restore parts of the floodplain.
- Removal of redundant structures to reconnect the watercourse and the floodplain.
- Avoid placing new development within the floodplain. For those sites considered within the Island Plan and / or put forward by developers, that are at risk of inland flooding associated with a watercourse flowing through or past them, development (where possible) should be located away from the watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity could potentially increase flooding. Further guidance is provided in Section 8.

6.3 Upstream natural catchment management methods

Opportunities to work with natural processes to reduce flood risk should be sought where available. Working with natural flood prevention processes has many benefits including a positive impact on the natural environment and a reduction in the costs of flood mitigation schemes. Methods of working with natural processes to mitigate flooding are discussed below.

Natural Flood Management

Natural Flood Management (NFM) involves techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters. NFM techniques include the following:

- watercourse restoration and enhancement
- catchment and floodplain woodlands
- instream large woody structure
- land and soil management practices
- agricultural and upland drainage practices
- non floodplain wetlands
- overland sediment traps
- flood storage areas

Details of further guidance on NFM techniques, their benefits, and methods of implementation are provided in Table 6-1.

Table 6-1 Natural Flood Management guidance documents

Document title	Web Link
SEPA Natural Flood Management Handbook	https://www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf
Natural Flood Management Measures: A Practical Guide for Farmers (North West)	https://catchmentbasedapproach.org/learn/natural-flood-management-measures-a-practical-guide-for-farmers-north-west/
Working with Natural Processes to reduce flood risk- The evidence behind Natural Flood Management	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/654440/Working_with_natural_processes_one_page_summaries.pdf
Working with Natural Processes –Evidence Directory	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/681411/Working_with_natural_processes_evidence_directory.pdf

6.4 Opportunities for strategic flood risk management in Jersey

There is considerable risk of inland flooding identified for the catchment which drains towards the Grands Vaux Reservoir, which is at risk of overtopping from significant rainfall events. The areas upstream of the reservoir are comprised of steep areas immediately adjacent to the watercourses, however, the nature of the land uses (agricultural etc) within the wider catchment present potential opportunities for Natural Flood Management (NFM). Implementation of catchment woodlands and instream large woody structures in the two streams that flow into the Grands Vaux Reservoir would help to mitigate flood risk.

A natural flood storage area could also be implemented to the north of Beaumont which could mitigate the rate of flow in the watercourse which flows through the east of Beaumont. Instream mitigation and flood woodland would be suitable for the other watercourses along the south of the island which flow into Millbrook and Bellozanne.

Recommendation

The Government of Jersey could further explore opportunities for strategic management of inland flooding throughout the island through development of a Catchment Flood Management Plan (CFMP). This can cover the whole island and/or selected key catchments identified to contribute to existing and predicted inland flooding.

A CFMP should consider all types of inland flooding including surface water, watercourse and reservoir and include:

- the likely impacts of climate change
- the effects of how we use and manage the land
- how areas could be developed to meet our present day needs without compromising the ability of future generations to meet their own needs

A CFMP can help the Government of Jersey and their partners to plan and agree the most effective way to manage inland flood risk in the future.

7. Flood risk framework

7.1 Overview

Considering the present day and future flooding risks that face the island, the Government of Jersey is seeking to adopt an approach within the Island Plan Review to ensure that development will achieve suitable resilience to the challenges of flood risk. A Flood Risk Framework has been developed for Jersey and is set out in this Section. The purpose of the Flood Risk Framework is to:

- Define **Flood Risk Categories**, based on the probability of flooding from coastal and inland flooding;
- Define **Vulnerability Classifications** for different types of development based on their sensitivity to flooding;
- Use the Flood Risk Categories and Vulnerability Classifications to (1) specify the types of development that may or may not be acceptable in different Flood Risk Categories, and (2) define the appropriate approach to planning decisions for each scenario.

Where possible, development which is vulnerable to flooding; or which could increase the probability of flooding elsewhere should be located away from areas at risk of flooding. The avoidance of flood risk, by not locating development in areas at risk of flooding, is recognised as a key part of delivering sustainable flood risk management.

7.2 Flood risk categories

Flood risk categories have been established, based on the probability of **coastal** flooding and **inland** flooding.

<u>The risk of **coastal flooding** has been defined in the following categories</u>:

- **High risk** has been identified using the 1 in 200 year outline (0.5% AEP) for the present day; and

Appendix B Figures 2 and 2A-2H

- **Medium risk** has been identified using the 1 in 200 year outline (0.5% AEP) for 2120.

Appendix B Figures 3 and 3A-3H

These return periods were chosen due to the size of the flood extents creating the worst-case modelled scenario for coastal flooding; and for consistency with the established approach used in parts of the United Kingdom.

<u>The risk of **inland flooding** has been defined into the following categories</u>:

- **High risk** of flooding means the area has a chance of flooding corresponding to a 1 in 30 year return period event (3.33% AEP);
- **Medium risk** of flooding means the area has a chance of flooding corresponding to a 1 in 100 year return period event (1% AEP); and,
- **Low risk** of flooding means the area has a chance of flooding corresponding to a 1 in 1000 year return period event (0.1% AEP).

Appendix B Figures 4 and 4A-4H

These return periods were chosen for consistency with the established approach used in parts of the United Kingdom. These flood risk categories are also summarised in Table 7-1.

Table 7-1 Flood Risk Categories

Risk Category	Inland Flooding	Coastal Flooding
Little or No Risk	Annual probability of inland flooding is less than 0.1% AEP (1 in 1000-year probability).	-
Low Risk	Annual probability of 0.1% AEP (1 in 1000-year probability) inland flooding risk.	-
Medium Risk	Annual probability of 1% AEP (1 in 100-year probability) inland flooding risk.	Annual probability of 0.5% AEP (1 in 200-year probability plus a 2120 epoch for climate change) flood event.
High Risk	Annual probability of 3.3% AEP (1 in 30-year probability) inland flooding risk.	Annual probability of 0.5% AEP (1 in 200-year probability for the present day) flood event.

The calculated probability of a flood occurring should be regarded as a best estimate and not a precise forecast. The annual probabilities referred to in Table 7-1 relate to the land at the time a planning application is made, or a development plan is prepared.

7.3 Vulnerability classifications

When making decisions about the suitability of development in relation to the risk of flooding, it is also necessary to consider the sensitivity of the proposed development or land use to flooding. This is referred to as the vulnerability of the development. Development types have been assigned a vulnerability classification based of the significance of the impacts that would occur if the development were to flood. The vulnerability classifications are defined in Table 7-2.

Table 7-2 Development Vulnerability Classifications

Vulnerability Classification	Development Definitions
Essential Civil Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines. • Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Hospitals.
Highly Vulnerable	• Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure'). • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses such as health services, nurseries and educational establishments. • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; and assembly and leisure. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.
Water Compatible	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

7.4 Development suitability and planning approach

Using the Flood Risk Categories (Table 7-1) and the Vulnerability Classifications (Table 7-2), this Section sets out the approach the Government of Jersey is recommended to take in relation to planning decisions across the island.

The approach differs for built up areas and countryside areas to avoid locating more vulnerable developments within areas which may not have supporting flood management measures. Table 7-3 (for built up areas) and Table 7-4 (for countryside areas) specify the types of development that may or may not be acceptable in different Flood Risk Categories and define the appropriate approach to planning decisions for each scenario.

Where a development site is identified at risk of flooding, even if it is only a low risk, it is necessary for the development proposals to acknowledge this risk and identify suitable mitigation so the impacts of flooding can be managed, enabling the development and its occupants to be more resilient to flooding and climate change. It is recommended that a Flood Risk Assessment (FRA) is prepared for any development within an area identified at low, medium or high risk of flooding in order to assess the risk of flooding; potential mitigation; and its acceptability in relation to flood risk. The level of detail required within the FRA should be proportionate to the level of risk and vulnerability category of the proposed development. Further information regarding FRAs is included in Appendix D.

Table 7-3 Development Suitability and Planning Approach – Built up areas

Built up areas

Flood Risk Category (See Table 7-1)	Essential Civil Infrastructure	Highly vulnerable	Less vulnerable	Water compatible
High	X	—	—	✔
Medium	—	—	✔	✔
Low	—	✔	✔	✔
Little or No risk	✓	✓	✓	✓

✓ *– Development is appropriate* ✔ *– Development is appropriate subject to mitigation*

— *- Development will need to identify wider justification for its location* X *– Development should not be permitted*

Table 7-4 Development Suitability and Planning Approach – Countryside areas

Countryside Areas

Flood Risk Category (See Table 7-1)	Essential Civil Infrastructure	Highly vulnerable	Less vulnerable	Water compatible
High	X	X	—	✔
Medium	—	—	✔	✔
Low	—	✔	✔	✔
No risk	✓	✓	✓	✓

✓ *– Development is appropriate* ✔ *– Development is appropriate subject to mitigation*

— *– Development will need to identify wider justification for its location* X *– Development should not be permitted*

The allocation of land as part of the Island Plan review process (i.e. where ‘countryside’ is effectively being proposed to be incorporated into the ‘built-up area’) should be undertaken on a risk based approach where development is steered towards those sites at least risk, prior to those with a higher risk. A site assessment spreadsheet has been developed to support this assessment process. The aim is to steer new development to areas with the lowest risk of flooding. If it is not possible for development to be located in zones with a lower risk of flooding, further assessments may be required to provide justification for the location of the development and/or identification of suitable mitigation measures in accordance with the Flood Risk Framework outlined above.

Policy Recommendation 1

Where possible, development which is vulnerable to flooding or could increase the probability of flooding elsewhere should be located away from areas at risk of flooding.

Where it is not possible to allocate development away from areas at risk of flooding, the Government of Jersey require development to be assessed based on its spatial location and subsequent exposure to inland and/or coastal flooding within a risk category (as set out in Table 7-1) and its vulnerability to flooding within a risk category (as set out in Table 7-2). Based on this categorisation, Table 7-3 provides a strategic flood risk framework against which the suitability of development in built-up areas for each of these risk categories can be assessed. Table 7-4 provides the same for the strategic assessment of flood risk for development in the remainder of the island’s coast and countryside.

A Flood Risk Assessment (FRA) is required for any development within an area identified at low, medium or high risk of flooding.

8. Site specific flood risk management measures

The majority of the island of Jersey is protected by the presence of coastal flood defences that mitigate the current flood levels. The likelihood of flooding from the tide is a residual risk, and flooding would only occur if the defences are overtopped. The risk of flooding from climate change poses a significant risk to Jersey so it is important to ensure that new development will not be at risk from flooding as a result of climate change. The following mitigation measures should be used to manage the risk of tidal and inland flooding in new developments. Mitigation measures should be implemented at a site level to help avoid and prevent flooding in a development site, before implementing building design measures to manage the impacts of flooding to a development.

8.1 Site measures

8.1.1 Development along watercourses, coastline and coastal flood defences

The Government of Jersey should seek a buffer strip alongside areas of coastline or coastal defences to ensure access for maintenance purposes and the implementation of future risk management schemes. An undeveloped buffer strip alongside watercourses for maintenance purposes should also be required. Developers are asked to explore opportunities for watercourse restoration or additional natural methods to help reduce inland flooding (refer to Sections 6.2 and 6.3 for further information).

In England, the Environment Agency have flood risk permitting distances of 8m from a main river fluvial watercourse and 16m from any tidal main river or flood defence structure (whether the structure is tidal or fluvial). These distances are not exclusion zones, but distances where they will scrutinise proposals with regard to:

a) potential impacts on defence integrity e.g. loading on ground close to the defence, potential damage to ground anchors and tie rods etc.
b) impacts on the ability to access defences for inspection, repair and maintenance.
c) the future ability to reconstruct or improve the defence (need to safeguard land).

The Government of Jersey should explore an appropriate width of buffer strip alongside areas of coastline, coastal defences and watercourses. A minimum distance of five meters from existing designated defences is currently required by the Drainage (Jersey) Law 2005.

Policy Recommendation 2

Retain an undeveloped buffer strip of predetermined width alongside areas of coastline or tidal flood defences. Retain an undeveloped buffer strip of predetermined width alongside any watercourses.

Developments should seek to implement opportunities for watercourse restoration or additional natural attenuation on sites which are bound by a watercourse (natural or culverted) or it is contained within the boundary.

8.1.2 Vulnerability of proposed uses

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to avoid and reduce the risk of flooding within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding. Where possible, built development should be located in the lowest risk areas (considering all sources of flooding) e.g. residential elements should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas can be placed on lower ground where there may be a higher probability of flooding.

Policy Recommendation 3

Where possible, development should be located in the areas at lowest risk of flooding within the site.

8.1.3 Land raising

In areas at risk of flooding of low depths (<0.3m), land raising can be used as a way of mitigating the risk of flooding. Land raising can be used to prevent flooding on a short term basis to provide time to move valuables out of an area at risk of flooding. It is important to ensure that land raising does not impact development nearby to the site.

8.1.4 Landscaping

In order to demonstrate that flood risk is not increased elsewhere, development in the floodplain will need to prove that flood routeing is not adversely affected by the development. Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

Potential overland flow paths should be determined, and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths or using earth bunds to manage flood water and improve flood routeing. It is important to ensure any mitigation measures do not divert water towards other properties elsewhere.

Policy Recommendation 4

All new development in areas at risk of inland flooding should not adversely affect flood routeing and thereby increase flood risk elsewhere. Opportunities should be sought within the site design to make space for water, such as:

- Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).
- Considering alternatives to solid wooden gates or ensuring that there is a gap beneath the gates to allow the passage of floodwater.
- On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to the watercourse when levels recede.
- Create under-croft car parks or consider reducing the ground floor footprint and creating an open area under the building to allow flood water storage.

8.1.5 Sustainable drainage systems

Sustainable drainage systems (SuDS) can be used in all types of development to provide a natural approach to managing drainage. SuDS are used to prevent water pollution and flooding in urban areas and can also create green spaces and habitat for wildlife.

SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible. Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below:

- Reduce flood risk (to the site and neighbouring areas);
- Reduce pollution; and,
- Provide landscape and wildlife benefits.

Generally, the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:

1. Store rainwater for later use
2. Use infiltration techniques, such as porous surfaces;

3. Attenuate run-off in open water features for gradual release to a watercourse;
4. Attenuate run-off by storing in tanks or sealed water features for gradual release to a watercourse;
5. Discharge run-off direct to a watercourse;
6. Attenuate rainwater by storing in tanks or sealed water features for gradual release to a surface water drain; and
7. Discharge rainwater to the public surface water sewer

SuDS should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible. SuDS must be implemented for all development sites unless it is demonstrated that SuDS are not suitable, such as:

- They would be likely to cause significant land or water pollution;
- The site's ground conditions would preclude their use;
- The size of the site would prevent their use;
- They would cause damage to adjacent buildings or sites.

Discharges of surface water to groundwater, or to local watercourses and waterbodies will be required to meet quality standards and conditions set by the Government of Jersey and will not be permitted where this would lead to pollution.

All developments should not result in an increase in overland flow, and where possible, should demonstrate betterment in terms of rate and volumes of overland runoff.

SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc.). The SuDS Manual[35] identified several processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge.

- **Infiltration**: the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. However, due to the geology of the island, this is unlikely to be possible in the majority of locations.
- **Detention/Attenuation**: the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.
- **Conveyance**: the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.
- **Water Harvesting**: the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

As part of any SuDS scheme, consideration should be given to the whole life management and maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Table 8-1 outlines typical SuDS techniques.

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted; each development site must offset its own increase in runoff and attenuation cannot be "traded" between developments.

[35] CIRIA C697 SuDS Manual. Available online from: http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx

Table 8-1 Typical SuDS Components (Y: primary process, * some opportunities subject to design)

Technique	Description	Conveyance	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specified retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.	*	*	*	Y

Policy Recommendation 5

New development and redevelopment should incorporate Sustainable Drainage Systems (SuDS) into the overall design. Areas of impermeable surfaces should be kept to a minimum in all new developments.

Surface water run-off should be discharged as high up the following hierarchy of drainage options as practicable:

1. Store rainwater for later use
2. Use infiltration techniques, such as porous surfaces;
3. Attenuate run-off in open water features for gradual release to a watercourse;
4. Attenuate run-off by storing in tanks or sealed water features for gradual release to a watercourse;
5. Discharge run-off direct to a watercourse;
6. Attenuate rainwater by storing in tanks or sealed water features for gradual release to a surface water drain; and
7. Discharge rainwater to the public surface water sewer

SuDS should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible. SuDS must be implemented for all development sites unless it is demonstrated that SuDS are not suitable, such as:

- They would be likely to cause significant land or water pollution
- The site's ground conditions would preclude their use
- The size of the site would prevent their use
- They would cause damage to adjacent buildings or sites.

Discharges of surface water to groundwater, or to local watercourses and waterbodies will be required to meet quality standards and conditions set by the Government of Jersey and will not be permitted where this would lead to pollution.

All developments should not result in an increase in overland flow, and where possible, should demonstrate betterment in terms of rate and volumes of overland runoff.

8.1.6 Reducing flood risk from sewers

Developers of any sites (regardless of their size) that could result in an increase in discharge to the public sewer network should check the capacity of the local public sewer network with the Government of Jersey at the earliest possible stage in the planning process to ensure that there is sufficient capacity. All new developments should avoid illegal connection of surface water to the foul water system, seek to improve the drainage infrastructure and reduce the risk of flooding, without increasing the risk of flooding elsewhere.

Simple measures including non-return valves fitted to foul chambers and wastewater outlets can help protect individual properties from both inland flooding and sewer flooding by preventing water entering the property via the drains and sewers. These can be easily incorporated into both new and existing developments.

8.2 Building measures

8.2.1 Flood resilient design

While flood defences protect the majority of the island from coastal flooding, the risk of flooding from climate change poses a significant risk. It is important to ensure that new development will be resilient to flooding from climate change.

Internal flooding of a development could occur if the defences are overtopped and flood depths are high enough that water would enter a development. If flooding of depths of greater than 0.6m was to occur as a result of defence overtopping, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable.

Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively, sacrificial materials can be included for internal and external finishes; for example, the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:

- Use materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances and utility metres.
- Coat walls with internal cement-based renders; apply tanking on the inside of all internal walls.
- Ground supported floors with concrete slabs coated with impermeable membrane.
- Tank basements, cellars or ground floors with water resistant membranes.
- Use plastic water resistant internal doors.

Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[36].

Structures such as bus, bike shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

Policy Recommendation 6

Developments located in areas at high, medium or low risk of flooding should be designed to be resilient to flooding, where it is deemed appropriate that they will be subject to internal flooding. This includes structures which form part of the public realm, such as bins and benches.

8.2.2 Finished floor levels

Where developing in an area at medium or high risk of coastal flooding is unavoidable, the recommended method of mitigating flood risk to people, is to ensure internal floor levels are raised a certain amount above the 1 in 200 year (0.5% AEP) flood level (also known as a freeboard level). Highly vulnerable development should also aim to raise floor levels 300mm above the 1 in 200 year (0.5% AEP) plus the 2120 epoch for climate change predicted flood level. Where this is not achievable, further mitigation measures (shown in the following sections) should be incorporated to manage the risk. These measures should be detailed within the FRA.

In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Government of Jersey should be

[36] CLG (2007) *Improving the Flood Performance of New Buildings, Flood Resilient Construction*. Available online from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

approached to discuss options for a reduction in the minimum internal ground floor levels provided flood resistance measures are implemented up to an agreed level.

Policy Recommendation 7

All development in areas at medium or high risk of coastal flooding (as defined in Table 7-1) should have Finished Floor Levels a minimum of 300mm above the 1 in 200 year (0.5% AEP) flood level. Highly Vulnerable development in areas at medium or high risk of coastal flooding should have Finished Floor Levels a minimum of 300mm above the 1 in 200 year (0.5% AEP) flood level for the year 2120 to account for the future impact of climate change.

A summary of the still water levels around the island is presented in detail within Appendix B(b) of the Jersey Shoreline management Plan (Still Water Level Report)[37]. The still water levels used in the coastal modelling are summarised for the 0.5% AEP below:

- 0.5% AEP still water level projected for **2020** – 6.95 m OD
- 0.5% AEP still water level projected for **2120** – 7.77 m OD

Appendix B Figures 10 and 10 A - 10H identifies potential depth of flooding (in metres above the existing ground level) during a high risk coastal flood event in 2040 in the priority areas at risk from overtopping (St Ouen's Bay, St Brelade's Bay, St Aubin's Bay, Havre des Pas, La Grève D'Azette, La Mare, Le Nez Point to Le Hocq Point, La Rocque, Royal Bay of Grouville and Archirondel (north)).

Appendix B Figures 10 and 10A-H

8.2.3 Property flood protection devices

There are a range of property flood protection devices available on the market, designed specifically to resist the passage of floodwater. These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with inland flooding and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devices such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

Such measures are not encouraged within new developments or the refurbishment of existing development as they require active intervention to achieve a reduction in the impact of flooding. These measures should only be considered as a last resort if all other mitigation options have been considered and robustly justified that they are not achievable on the individual development site.

8.2.4 Flood Evacuation Plans for areas at risk of flooding from overtopping of a reservoir

As discussed in Section 4.2.4, the town of St Helier is potentially at risk of flooding from the Grands Vaux Reservoir if it was to overflow as a result of a significant rainstorm affecting the catchment. Jersey Water manage the levels of water in the reservoirs for the purpose of water supply.

If the levels of water are unable to be mitigated due to the volume of rainfall within the catchment, evacuation may be required where residents of an area need to be evacuated due to the risk of flooding in the valley. Flood warnings may be able to be issued if the storm is predicted and levels are expected to cause reservoir overtopping. However, overtopping may still occur due to flash flooding (which was unpredictable) upstream of the reservoir.

To enable timely action by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises, a Flood

[37] Government of Jersey (2020) Jersey Shoreline Management Plan Appendix B(b) Still Water Level Report. Available online at: https://www.gov.je/SiteCollectionDocuments/Environment%20and%20greener%20living/R-Shoreline%20Management%20Plan%20Appendix%20B(b)%20Still%20Water%20Level%20Report%2020200205%20HL.pdf

Evacuation Plan should be prepared. Rescue by the emergency services is likely to be required where flooding has occurred, and prior evacuation has not been possible.

For all developments at risk of flooding from reservoir overflow a Flood Evacuation Plan should be prepared to identify the evacuation route from the site, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard people within existing properties. Flood warnings and guidance on large-scale evacuations will be provided by the Government of Jersey as identified in its Grands Vaux Flood Plan[38].

Policy Recommendation 8

A Flood Evacuation Plan should be prepared for any new developments which are located with an area identified at risk of inundation from reservoir overtopping associated with either the Grands Vaux or Millbrook Reservoirs. The Flood Evacuation Plan should demonstrate the route which would be used to evacuate a site during a reservoir overtopping flood event.

The development proposals should also be supported with a Flood Risk Assessment in order to assess the risk of flooding and detail the potential site specific mitigation measures required to support the Flood Evacuation Plan.

To support implementation of this recommendation it will be necessary for the Government of Jersey to clearly identify the areas at risk of inundation from reservoir overtopping associated with both the Grands Vaux and Millbrook reservoirs. The spatial extent for Grands Vaux Reservoir is indicated in the Grands Vaux Flood Plan but the information is incomplete in the published version. The spatial extent for Millbrook Reservoir is not currently in the public domain.

[38] Government of Jersey (2018) *Grand Vaux Flood Plan*. Available online at: https://www.gov.je/SiteCollectionDocuments/Staying%20safe/SoJ%20Grand%20Vaux%20Flood%20Plan%20v2.1.pdf

9. Cumulative development and land use change

9.1 Cumulative impacts

In addition to consideration of flood risk within the development site, it is important to consider the effect on the surrounding area. Where development takes place on an area subject to flooding, it may change the pattern of flood risk. In particular, an additional built-up area may reduce the space for flood water causing it to be diverted elsewhere. This is an important consideration for areas at risk of tidal and inland flooding as the diversion or displacement of flood water could put properties that are not modelled to be at risk of flooding at risk. To mitigate the displacement and diversion of flood water, mitigation measures and appropriate building placement should be used to avoid this. Techniques such as providing alternative flood plain storage, diverting inland flood flows into areas of planting or the use of sustainable drainage systems (SuDS) can be used to mitigate the risk of flooding. Further guidance on methods to mitigate flooding are provided in Section 8.

Furthermore, it is not sufficient to assume that locating development away from areas of tidal risk and inland flooding areas and the use of SuDS will automatically render flood risk to third parties adequately low irrespective of location. A situation may arise in which there is no spare capacity in a drainage system to take additional flows from a new development. It is important to confirm with the Government of Jersey that sufficient capacity is available in the drainage system to ensure that flooding does not occur in the development or further down the drainage system.

9.2 Land-use change

9.2.1 Paving

The paving over of front and back gardens can increase the risk of flooding in urbanised catchments. An increase in impermeable areas causes larger amounts of runoff (during periods of heavy rain) than a traditional lawn or permeable surface. This runoff can cause a build-up of water on roads and in areas vulnerable to inland flooding. Increased runoff can also contribute to increased pressure on drainage and sewer systems. Where possible, permeable methods should be used to ensure runoff is not increased. Further guidance on permeable surfaces is provided in Section 8.

9.2.2 Rural land management

The increasing frequency and magnitude of flooding can also be partially attributed to changes in rural land use management, for example tree removal, land drainage and intensification of crop cycles and animal stocking. The effects on overland flows and inland flooding are usually subtle and difficult to predict especially at larger scales. There is strong evidence that small scale catchment management approaches can deliver flood risk management benefits. Farmland can store floodwater to reduce the risk of flooding downstream within the catchment. Large washland (storage) areas can be designed to store excess water and slow down flood peaks. Additional guidance on using Natural Flood Management (NFM) methods is provided in Section 6.3.

10. Recommendations for policy and guidance

10.1 Overview

This SFRA has identified the areas which are at risk of flooding from a number of different sources. To ensure that future development in Jersey addresses these risks and does not contribute towards increasing them, site specific flood mitigation measures should be implemented to manage flooding. Development should also not hinder the preferred long term management approaches outlined within the SMP and other flood mitigation strategies in Jersey.

It is recommended that the policy recommendations identified throughout the SFRA are implemented into future updates in flood risk planning policy.

10.2 Guidance

The Flood Risk Framework and supporting policy recommendations make reference to the need to prepare Flood Risk Assessments (FRAs) for developments within areas identified at risk of flooding. Further guidance has been provided on the preparation of site specific FRAs in Appendix D.

Appendix A Data Register

	Dataset	Source	Format	Description	Limitations	Map
Topography	LiDAR data (DTM, ASCII)	Government of Jersey	GIS Layer	The Government of Jersey LiDAR data contains digital elevation data derived from surveys carried out in 2017. The data has a spatial resolution of 2m.	None	Appendix B Figure 1
Coastal	Risk of tidal flooding present day	Government of Jersey	GIS Layer	This dataset covers the modelled outline of the 0.5% annual exceedance probability (AEP) of tidal flooding (1 in 200 chance each year).	The information provided is largely based on modelled data and is therefore indicative rather than specific. Locations may also be at risk from other sources of flooding, such as inland flooding from heavy rain, or failure of infrastructure such as sewers and culverts. The information indicates the flood risk to areas of land and is not sufficiently detailed to show whether an individual property is at risk of flooding, therefore properties may not always face the same chance of flooding as the areas that surround them. This is because we do not hold details about properties and their floor levels.	Appendix B Figure 2 and Figures 2A – 2H
	Risk of tidal flooding with future climate change allowances	Government of Jersey	GIS Layer	This dataset covers the modelled outline of the 0.5% annual exceedance probability (AEP) of tidal flooding (1 in 200 chance each year) in the future epochs: Short term – 2040 Medium term – 2070 Long term – 2120		Appendix B Figure 3 and Figures 3A – 3H
	Areas at risk of coastal defence overtopping	Government of Jersey	GIS Layer	This dataset covers the defences which are modelled to be overtopped during a 0.5% AEP plus long term (2120) climate change flood risk scenario.		Appendix B Figure 9
Inland	Risk of inland flooding present day	Government of Jersey	GIS Layer	Provides an indication of the broad areas likely to be at risk of inland flooding, i.e. areas where surface water would be expected to flow or pond. This dataset covers the modelled outline of the following rainfall events: • 3.3% AEP of inland flooding (1 in 30 chance each year) • 1% AEP of inland flooding (1 in 100 chance each year) • 0.1% AEP of inland flooding (1 in 1000 chance each year)	This dataset does not show the susceptibility of individual properties to inland flooding.	Appendix B Figure 4 and Figures 4A – 4H

	Dataset	Source	Format	Description	Limitations	Map
	Risk of inland flooding including the effect of pumping stations	Government of Jersey	GIS Layer	Provides an indication of the broad areas likely to be at risk of inland flooding taking into account the main pumping stations. This dataset covers the modelled outline of the following rainfall events: • 3.3% AEP of inland flooding (1 in 30 chance each year) • 1% AEP of inland flooding (1 in 100 chance each year) • 0.1% AEP of inland flooding (1 in 1000 chance each year)	This dataset does not show the susceptibility of individual properties to inland flooding.	Appendix B Figure 5 and Figures 5A – 5H
	Risk of inland flooding with climate change allowances	Government of Jersey	GIS Layer	Provides an indication of the broad areas likely to be at risk of surface water flooding, i.e. areas where surface water would be expected to flow or pond. This dataset covers the modelled outline of the following rainfall events: • 3.3% AEP of inland flooding (1 in 30 chance each year) • 1% AEP of inland flooding (1 in 100 chance each year) Two percentage uplifts were considered for both of these return periods (+20% and +40%).	This dataset does not show the susceptibility of individual properties to surface water flooding.	Appendix B Figure 6 and Figures 6A – 6H
Historic Flooding	Flooding incidents and records	Government of Jersey	Email & spreadsheet	Anecdotal details of flood risk areas and a spreadsheet with records of historic flood events.	Some of the data is based on circumstantial and subjective evidence. There is not always available metadata, e.g. exact date of flood event or type of flooding etc.	Not mapped
Reservoirs	Flood Study Reports	Jersey Water	Reports	A flood study for each of the reservoirs was undertaken to assess compliance with the standard safety check recommended by the guide in respect of sufficient freeboard to accommodate surcharges from floods and wind waves during specific flood events.	None	Not mapped
	Grands Vaux Reservoir Flood Plan	Government of Jersey	Report	Emergency flood plan to manage the potential inundation resulting from overflow of the Grands Vaux Reservoir.	The flood plan only considers the inundation resulting from overtopping during a significant rainfall event.	Not mapped
	Inundation mapping and Quantitative Risk Assessment – Millbrook Reservoir	Jersey Water	Report	Inundation mapping and quantitative risk assessment for the potential overflow of Millbrook Reservoir.	None	Not mapped
Flood Risk Mana	Coastal flood assets	Government of Jersey	GIS Layer	Provides an overview of the defence condition	Snapshot of the condition of the defences in 2019.	Appendix B Figure 8 and

Dataset	Source	Format	Description	Limitations	Map
			assessment undertaken in 2019 as part of the Jersey SMP.		Figures 8A – 8H
Water impounding areas	Government of Jersey	Drawings	Identifies the type and location of the different water impounding areas across the island.	Locations approximated from the drawings provided.	

Appendix B Maps

Appendix C Pumping Station Catchment Areas

Appendix D Site Specific Flood Risk Assessments

D.1 What is a Flood Risk Assessment?

A Flood Risk Assessment (FRA) is a report prepared for a specific site suitable for submission with a planning application, which provides an assessment of flood risk to and from a proposed development. The FRA should demonstrate how flood risk will be managed now and over the lifetime of the development, taking climate change into account, and with regard to the vulnerability of its users.

The objectives of a site-specific FRA are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate.

D.2 When is a FRA required?

A Flood Risk Assessment (FRA) is required for any development within an area identified at low, medium or high risk of flooding (Table 7-1).

D.3 What should a FRA contain?

Table D-1 sets out the type of information that a FRA should typically contain.

Table D-1 Site specific FRA Checklist (developed from guidance in PPG[Error! Bookmark not defined.])

What to include in the FRA		*Source(s) of Information*
1. Site Description		
Site address	-	-
Site description	-	-
Location plan	*Including geographical features and street names*	*Government of Jersey Mapping*
Site plan	*Plan of site showing development proposals and any structures which may influence local flow paths e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel*	*Government of Jersey Mapping* *Site Survey*
Topography	*Include general description of the topography local to the site.* *Plans showing existing and proposed levels.*	*SFRA Appendix B Figure 1*
Geology	*General description of geology local to the site.*	-
2. Assessing Flood Risk		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Not all of the prompts listed below will be relevant for every application.		
Flooding from the tide	*Identify any parts of the site at risk of coastal flooding.* *Identify any historic flooding that has affected the site.* *Discuss how the site is likely to be affected by climate change?*	*SFRA Appendix B Figure 2 and 2a-2h* *SFRA Appendix B Figure 3 and 3a-3h*

Flooding from inland sources	*Identify any parts of the site at risk of inland flooding.* *Identify any historic flooding that has affected the site.* *Discuss how the site is likely to be affected by climate change?*	*SFRA Appendix B Figure 4 and 4a-4h* *SFRA Appendix B Figure 5 and 5a-5h* *SFRA Appendix B Figure 6 and 6a-6h*
Flooding from Sewers	*Identify any historic flooding that has affected the site.*	-
Flooding from Reservoirs	*Review the Risk of Flooding from Reservoirs mapping.*	*SFRA Appendix B Figure 7*
3. Proposed Development		
Current use	*Identify the current use of the site.*	-
Proposed use	*Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?*	-
Vulnerability Classification	*Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?*	*SFRA Table 7-2*
4. Managing and Mitigating Flood Risk		
Section 8 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions: *How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime?* *How will you ensure that the proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?* *Are there any opportunities offered by the development to reduce flood risk elsewhere?* *What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?*		
Development Layout	*Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.*	*SFRA Section 9*
Finished Floor Levels	*Plans showing finished floor levels in the proposed development taking account of indicated flood depths.*	
Flow Routeing	*Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased.*	
Watercourse or Coastline Development Buffer Zone	*Provide plans showing how a buffer zone of relevant width will be retained adjacent to any watercourse, coastline or flood defence in accordance with requirements of the Government of Jersey.*	
Drainage and Surface Water Management	*Provide evidence that SuDS have been used to manage overland flow (or sufficient justification if these cannot be used) and evidence that these will sufficiently manage the risk of surface water flooding. Demonstrate compliance with the existing legal requirements under the Drainage (Jersey) Law, 2005.*	
Flood Evacuation Plan (for areas at risk of flooding from the Grands Vaux Reservoir)	*Where appropriate reference the Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).*	

In applying the Flood Risk Framework (Section 1), developers and the Government of Jersey should also consider:

- the characteristics of the site,

- the use and design of the proposed development,
- the size of the area likely to flood,
- existing flood prevention measures – extent, standard and maintenance regime,
- cumulative effects of development, especially the loss of flood storage capacity,
- effects of a flood on access including by emergency services,
- effects of a flood on proposed open spaces including gardens, and
- the extent to which the development, its materials and construction are designed to be water resistant.

D.4 How detailed should a FRA be?

Site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification (Table 7-2). Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA.

For example, where the development is an extension to an existing house which would not significantly increase the number of people present in an area at risk of flooding, the Government of Jersey would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater, the Government of Jersey may require a more detailed assessment. As a result, the scope of each site-specific FRA may vary.

A FRA should comply with the Government of Jersey Island Plan policies and laws. Failure to provide sufficient information will result in an application being refused.