Vision for Water Management in the City of Edinburgh

Final: November 2020




Scottish Water
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SEPA
Scottish Environment Protection Agency

EDINBVRGH
THE CITY OF EDINBURGH COUNCIL

Foreword

The City of Edinburgh Council recognises Climate Change as a key challenge, both now and into the future, and we have set an ambitious target for Edinburgh being carbon neutral by 2030.

As part of this ambition we are looking at how the city can adapt to the challenges of the changing climate concerning water. Our city needs to adapt, and this Vision is the first step along this journey. We need to look at our rivers, our coastline, surface water and underground surface water sewers.

This is a significant shift for everyone involved in changing the surface of the city. From an individual householder, to a major developer or roads engineer, we all need to consider where the rain and river water should go, and also how rising sea levels could impact our coastline.

We are confident that by working together collaboratively with the different Agencies, we can not only adapt our city to improve its resilience, but also create a more beautiful and greener city to live in. Greening our city will not only make our neighbourhoods more attractive, it will help them to be cooler, making them more resilient to heatwaves. This will also support a greater wealth of habitats for wildlife and plants and in turn, will create healthier, happier and better off communities. We are confident that working together using the Vision as a roadmap we can make this happen.

Councillor Lesley Macinnes
Transport & Environment Convener

SEPA fully endorses and supports the City of Edinburgh Council Water Management Vision. For cities to thrive in a changing climate we must transform how we manage water and land as set out here. Success will secure the future of our urban areas, create better places to live, and improve biodiversity and we are fully committed to working in partnership to deliver those outcomes.

David Harley
Head of Water & Planning
SEPA

Scottish Water fully supports and endorses the City of Edinburgh Council Water Vision, which closely links with the ambitions Scottish Water have set out in our Strategic Plan ‘A Sustainable Future Together’. These lay the foundations for a transformational approach for storm water management across the urban environment in the City of Edinburgh, and drive us to work in collaboration to deliver the Vision, drive innovative planning and solutions to reduce flood risk, improve water quality and create a water resilient city for the future.

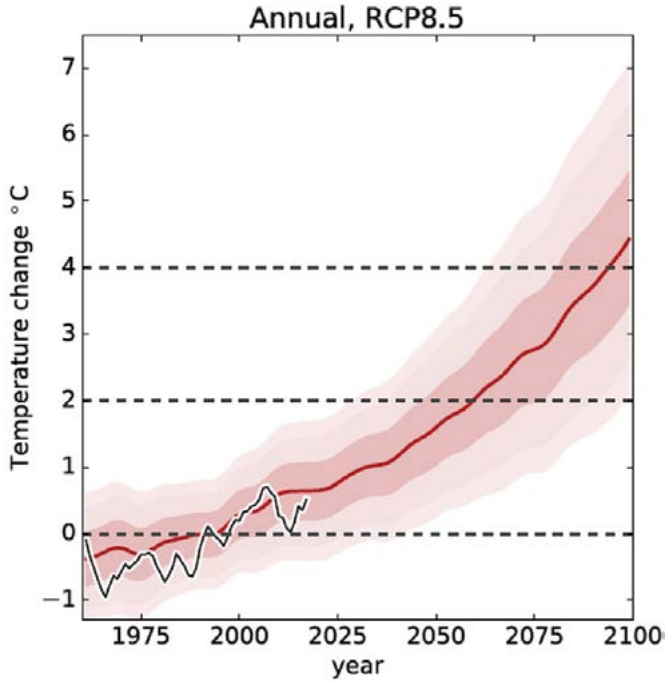
Simon Parsons
Director of Strategic Customer Service Planning
Scottish Water

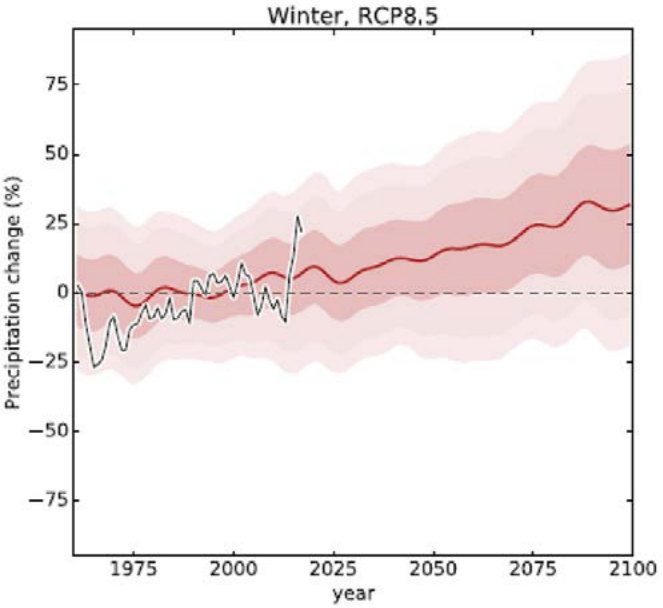
The climate is changing

Climate trends predict that we will experience warmer and wetter winters. Summers are expected to become hotter and drier, and occurrences of extreme rainfall events are expected to increase. Sea levels around our coast are predicted to rise, with an increase in storm surges during bad weather. Despite the overall trend there will still be cold, dry winters, and cool, dry summers, as there is variability in the summers and winters we see today.

The SEPA National Flood Risk Assessment 2018 estimates that in Edinburgh, there are currently 28,200 homes, business and services at risk of flooding from all sources in the 200-year flood event (rivers, the sea and surface water) and, due to climate change this could increase by 37% to 38,800 by the end of century.

In order to adapt the city and ensure all developments are mitigating and designing for climate change we need a common understanding across all the work within the council developed with input from Scottish Water (SW) and Scottish Environment Protection Agency (SEPA).





the Committee on climate change has advised the UK to prepare for a 4°C rise as shown in the graphs.

The vision sets out how the City of Edinburgh Council will adapt to the challenges of climate change with respect to the management of water.

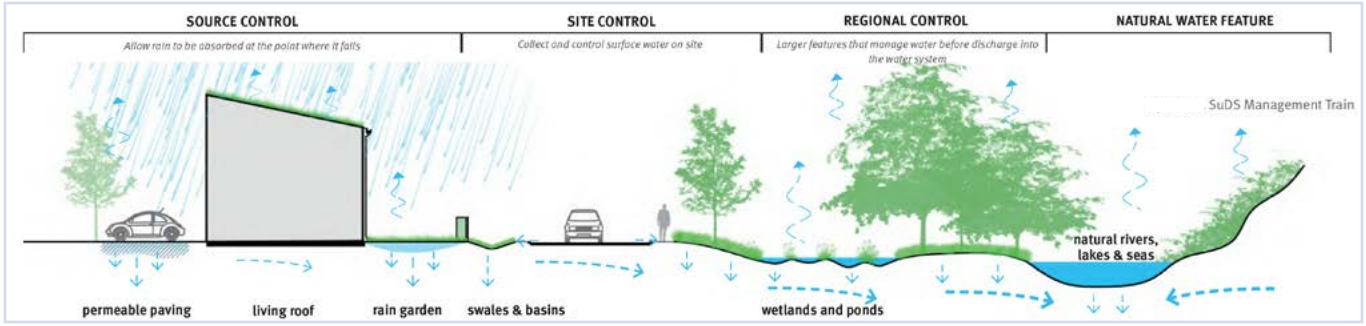
Our vision is;

To develop a long-term and sustainable approach to river, coastal and storm water management across the city and its environs, respecting our unique historic heritage. This will involve all stakeholders and address the flooding and water quality risks associated with our changing climate as a result of changes in rainfall and sea level rise.

The objectives can be summarised as follows:

- Improve the understanding of the current drainage network across the city, and current and future flood risk from all sources (river, coastal and surface water).
- Develop integrated drainage and surface water management plans across the city.
- Interpret the current guidance from SEPA concerning water management, flood risk and erosion as applied to our city.
- Support sustainable growth by taking a precautionary approach to locating different types and densities of development in locations according to risk of the flooding from all sources, utilising the hills and valleys of the city.
- Plan for the conveyance, attenuation and storage of storm water safely above ground for reuse and dispersal.

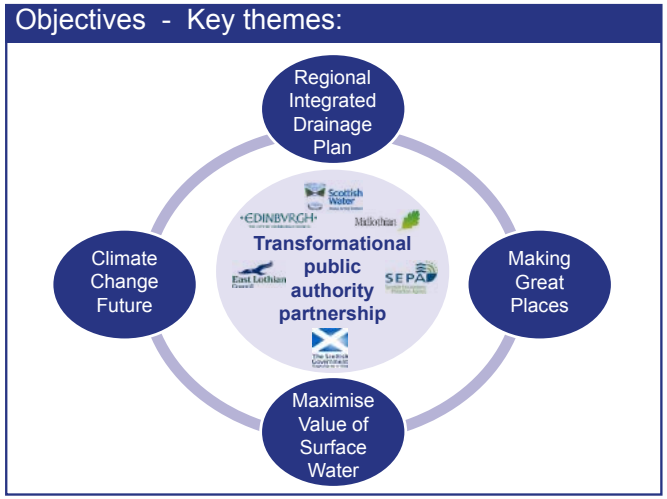
- Require all new development (and retrofit) to manage the first 5mm of rainfall at a plot level where appropriate and adhere to the SuDS Management train so run-off is managed in stages as it drains through and from a site.
- Ensure a citywide approach to water management utilising an interconnected green/ blue network which will be developed and embedded into the Local Development Plan.
- Work with all stakeholders to remove and reduce stormwater in the existing combined sewer network
- Do all the above whilst enhancing ecology, connectivity and social cohesion, creating beautiful and healthy places and respecting the unique heritage of the city.



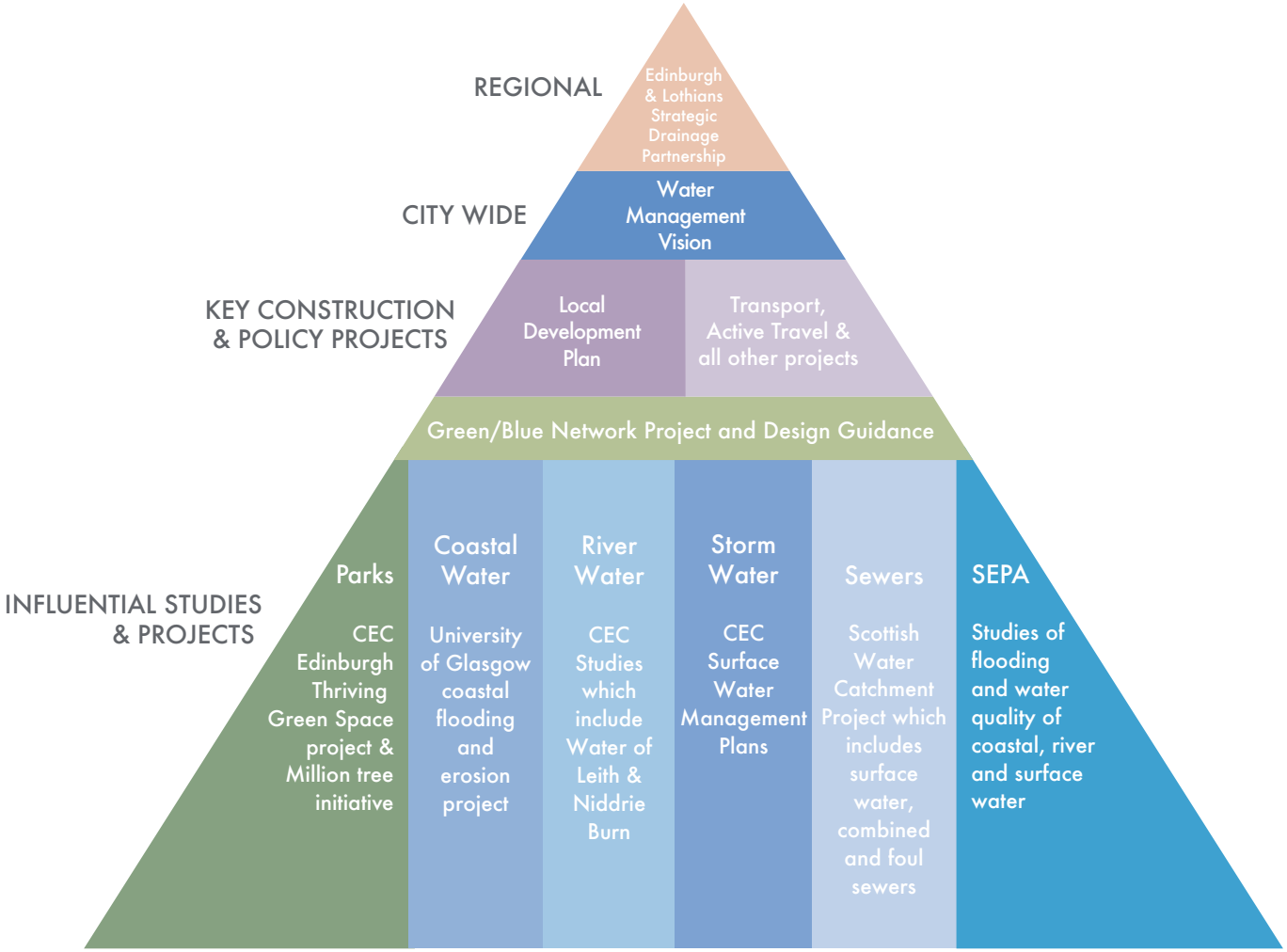
Source: Edinburgh Sustainable Rainwater Management Guidance CEC

The strategic approach will be facilitated by the Edinburgh and Lothains Strategic Drainage partnership.

The key themes and members of the partnership are:



The objectives will influence new projects and developments in the council.



This new way of working will enable the development of a city that is adaptive and resilient to climate change, that is also beautiful and biodiverse delivering a healthier, thriving and compact city with a higher quality of life for all residents.

The idea is to deliver transformational change in the way that water is valued and managed in the city.

This will require a change in the way development (new developments, re-developments, and public realm, infrastructure and roads projects), are designed, agreed, constructed and maintained. It will also require a change to the way open space is currently used.

Source: Dusty Gedge:
Solar Green Roof, Standard Chartered, London

Delivery and Implementation

This will challenge the council and its partners to seek new ways of funding capital and revenue work to consider climate adaptation. It will promote the use of new green infrastructure budgets to expand the green blue network and ensure adequate funds for long term maintenance. The potential for a dedicated fundraiser position jointly delivered by Scottish Water and the Council will be pursued.

Partnership Projects

There will be opportunities to develop capital funding for some schemes using partnership money from Scottish Water and funding partners like SUSTRANS. In all capital work where the council or developers have funding partners, the council would strive to include long term maintenance in the funding arrangements for areas that council would adopt.

If water has been permanently removed from a Scottish Water Surface Sewer as part of a project, then potentially an on-going arrangement with Scottish Water for the adopted areas using a Section 7 agreement would be used.

New Development

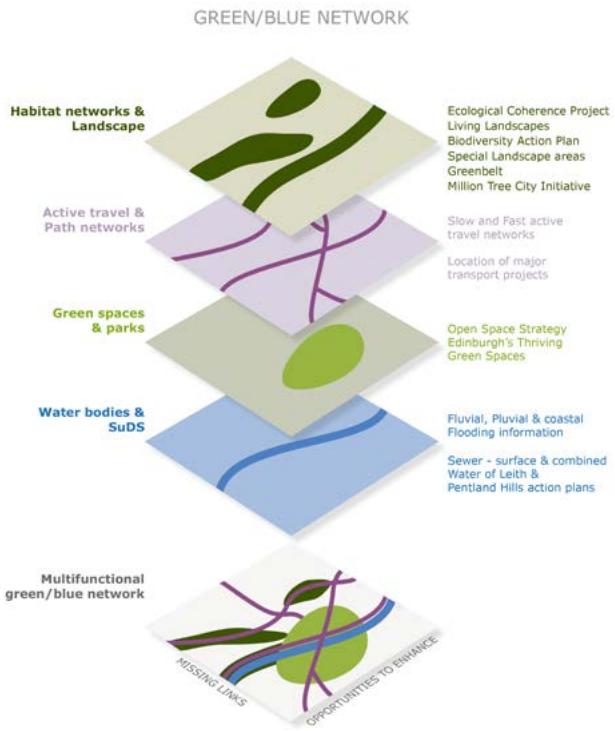
Further detailed work will be undertaken to identify the most appropriate approach to obtaining developer contributions for green infrastructure arising from new developments. This is likely to link to a new policy concerning overland flows and intensity of rainfall in the Local Development Plan to relevant water shed areas.

When the council is the acting as Roads Authority and implementing capital transport projects, water management will be implemented where possible depending on the scope and scale of the project.

With regards to roads, it might be more appropriate to use them as conduits for water to lead to safe, open green areas as opposed to attenuation within a project boundary, particularly in older parts of the city.

An education programme will be set up, looking at educating the residents and businesses of Edinburgh about water and climate change and expectations of how the city will look in the future. For example, it will be necessary to manage expectations of how the city's existing infrastructure can cope with rainfall with a return period much greater than what the roads, drainage and sewers were ever designed for. Even infrastructure designed to modern design standards cannot cope with the intensity of storms which are being experienced more and more often. Therefore, plans will be put in place to take that water safely away into greenspace, both private and public, where it will subside after the storm. It will also be explained that policy is not to take the water underground as this may cause sewer flooding elsewhere in the city.

Example of new projects that are taking forward the ideas of the vision.



In short: We need to understand what is happening now with water in the city and prepare for a future which has beautiful places, is rich in biodiversity, that is adaptable to our changing climate.

Biodiverse roof, 202 Bishopsgate London. Source: Dusty Gedge

Example of a SUDS pond. Source: RaeburnFarquharBowen.

Glossary :

Attenuation - Reduction of peak flow and increased duration of a flow event.

Combined Sewers - A sewer designed to carry foul sewage and surface runoff in the same pipe.

Conveyance - Movement of water from one location to another.

Understanding risk

The chance of a flood event can be described using a variety of terms. Floods are often defined according to their likelihood of occurring in any given year. The most commonly used definition in planning is the '1 in 200 year flood'. This refers to a flood level or peak that has a one in a two hundred, or 0.5%, chance of being equalled or exceeded in any year.

Other terms that express the same idea, such as 0.5% **annual exceedance probability** (or 0.5% AEP), are preferred because they avoid the common misconception that a '1 in 100 year flood', for example, can only occur once every 100 years; or that you are 'safe' for another 100 years after you experience such an event. In reality, the chance of experiencing different sized flood events in a given period of time can be estimated mathematically (see Table 1). If you lived for 70 years in a location that had a 1% chance of flooding in any one year (that is, it would only flood if a '1 in 100 year flood' occurred), then there would actually be a 50% chance, or one in two odds, of you experiencing at least one flood during that 70 year period.

Chance of a flood of a particular size being exceeded in any one year	Chance of experiencing a flood in a 70 year period	
	at least once	at least twice
10% (1 in 10 odds)	99.9%	99.3%
5% (1 in 20 odds)	97.0%	86.4%
2% (1 in 50 odds)	75.3%	40.8%
1% (1 in 100 odds)	50.3%	15.6%
0.5% (1 in 200 odds)	29.5%	4.9%

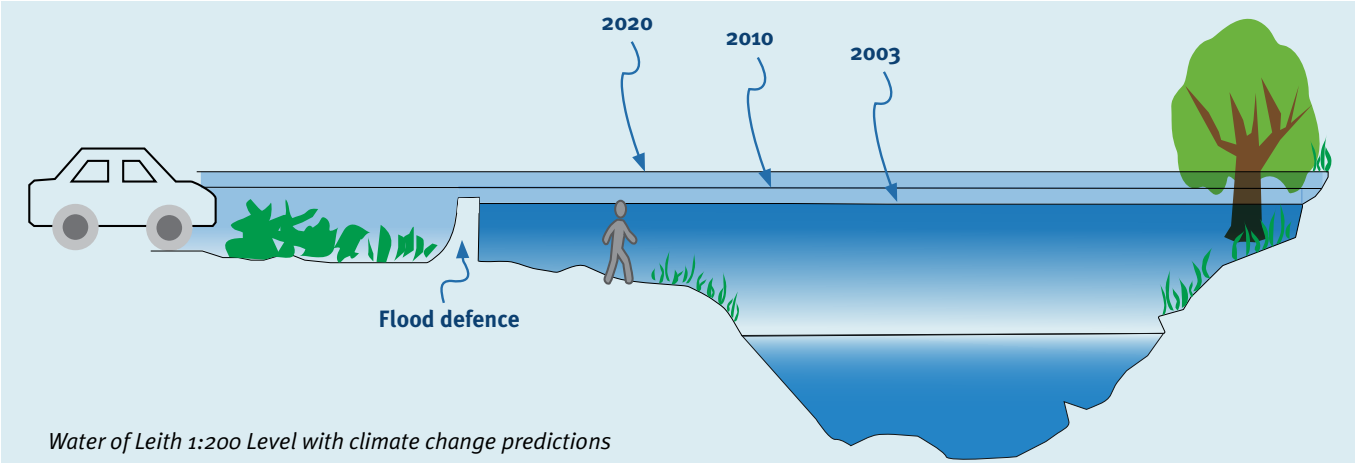
With climate change we expect these probabilities to rise and flooding currently with a predicted risk of 1:200 to become more frequent.

Recent storms in Edinburgh have been above the 1:200 level.

Reference:
Understanding Floods, Queensland Government page 23

Fluvial (Rivers)

It must also be remembered that our understanding of future flood risk improves all the time. For example, in Fluvial Risk (Rivers) we can look at an example like the Water of Leith flood alleviation scheme. In 2003 there was no requirement to take climate change into account. So the risk of a 1 in 200 flood event level was used to protect existing property. However, the Flood Alleviation Scheme took into account climate change and added a 12% allowance onto the 1 in 200-year level as we realised that the climate was changing (effectively the level of the predicted 1:200 flood was raised). It was believed at that time that a 12% allowance would be sufficient for many years to come. However, based on the latest climate science the recommended allowance first increased to 20% and SEPA's most recent guidance is now to allow for a 40%. SEPA is in the process of updating its climate change guidance to take account of the most recent information from the UKCP18 climate projections. What that means in reality is that the level once thought of providing protection to a 1 in 200 flood event over a development lifespan is no longer thought likely to do so, as in the future flood waters are expected to rise more frequently to the higher level. This trend is likely to continue, *but the extent is unknown*.



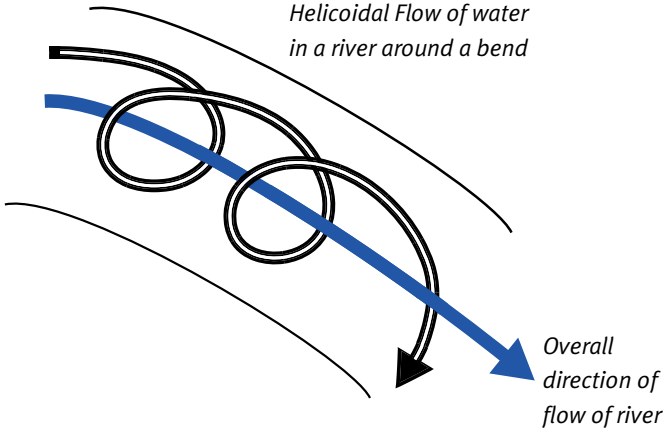
Water of Leith 1:200 Level with climate change predictions

We also have to base our understanding on the best information available at any given time and engineers and flood modelling experts use their technical expertise and judgement in interpreting what that means for flood risk. For example:

1. Large floods happen very rarely in any particular location, so scientists have to estimate their predictions assuming the rates are similar, of what could happen based on records of smaller events, or by combining records of similar catchments. More certainty in the outputs of models is achieved through real events and calibration of data. Estimates of the 200-year flood can therefore change as records of water levels increase in length or following large events;

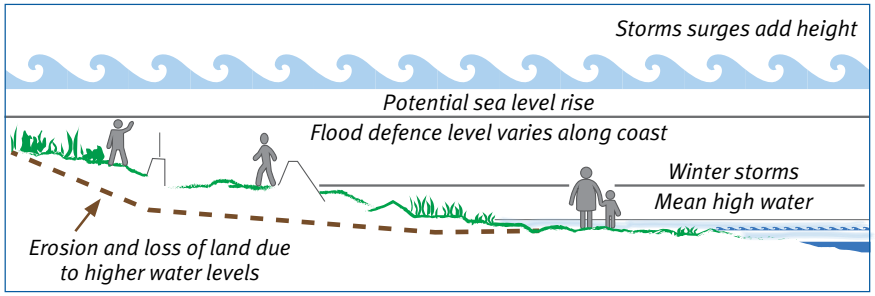
2. Computer models are used to predict the area at risk of flooding. The accuracy of these models is limited by available data such as river bed, drainage network or beach survey data.

3. The movement of water is incredibly complex so simplifications have to be made and modellers have to use their judgement to decide which of the factors which influence flooding are important to include in these models and how they should be included. As large flood events are rare, there is often little information to test how well models perform.



Edinburgh rivers have rural headwaters but then flow into an urban area with lots of impermeable surfaces and a complicated drainage network which modifies the natural catchments. Without adaptation, increasing impermeable surfaces has potential to increase flood flows in our watercourses on top of that caused by climate change. Our understanding of how climate change may affect intense short duration rainfall which is often responsible for flooding in steep or heavily urbanised catchments is not as well developed as our understanding of how climate change may affect longer duration rainfall events which cause flooding of larger rivers. Edinburgh is heavily urbanised, so although the climate allowances and flood maps are based on the best information available, they do not provide a single definite level for acceptable future flood risk. We need to decide our own 'risk appetite' i.e the willingness of us as an authority to accept the risk of flooding for current and future residents of our city.

Coastal - Sea Level



Even if emissions are reduced in line with the Paris agreement, sea levels are still expected to rise beyond the end of the century. Sea level rise is likely to increase the risk of coastal flooding and erosion and reduce the space available for the coastal habitats and wildlife. Sea level rise may also affect river and surface water flooding as higher sea levels can cause tide locking of surface water and river outfalls.

The sea level rise allowances in SEPA's land use planning guidance is set at a level which is very unlikely to be exceeded by 2100 but are as likely as not to be exceeded by 2150 under a 'business as usual' high emissions scenario. However, these models do not include the potential collapse of the west Antarctic Ice Sheet, and there is an unquantifiable risk that sea level rise by 2100 could be double that in SEPA's climate change allowances. The adaptation plan for the Thames Estuary already considers a high end scenario of a 3m increase in extreme sea levels by 2100, and the Dutch are now investigating the impact that 2m of sea level rise would have on their adaptation plans.

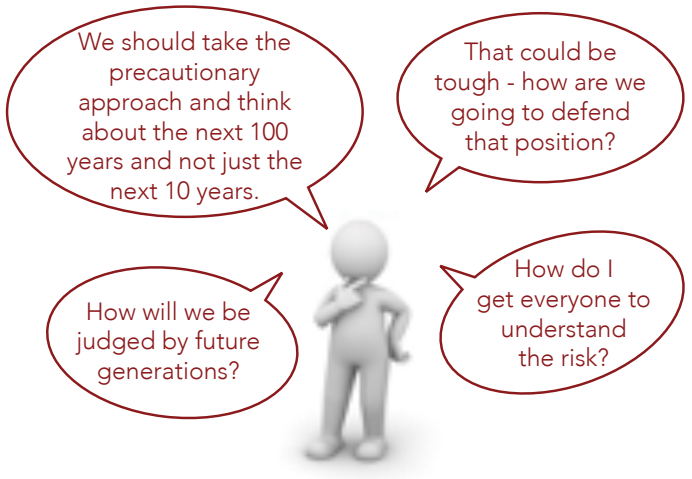
For exposed sections of coast, maximum wave heights are often limited by water depth. This means that as sea levels rise wave heights at the coast are likely to get bigger, leading to more flooding, erosion and damage to coastal defences than would be expected by sea level rise alone. Other factors which may increase the risks at coast include changes in storminess. This is generally thought to be negligible compared to Sea Level Rise but it is not known. There could be changes in the way in which tides change around the coast and within firths and estuaries. We don't know whether it will be an issue in the Forth as there is insufficient detailed data to be sure.

SEPA's flood maps show the risk from extreme still water levels which include storm surges and astronomical tides but not waves. These generally underestimate flood risk as wave overtopping is not included, but they could also overestimate in some areas.

Pluvial (Surface Water)

The intensity of rainfall will increase due to climate change. For the most part the city is drained through an underground network of gulleys, road drains, sewers and culverted watercourses. These piped systems have a fixed capacity, which can be overwhelmed in periods of very intense rainfall. The volume of rainfall is not able to enter the gulleys and to be drained underground quick enough and can lead to localised pluvial flooding in natural low spots, taking with it pollutants and debris. Current design practice for new development does look at overland flow paths, and managing rainwater above ground in a more sustainable approach. However, we have already seen older areas of the city, which rely on gulleys and underground pipes, being overwhelmed and it is widely acknowledge that, in the future, this will happen more regularly, exacerbated by Climate Change, and the growth of impermeable areas in the urban environment (paving over green space/ gardens).

Therefore, it is sensible to take a **precautionary approach** to all aspects of planning, retrofitting and maintenance concerning water from all sources. Further work will help understand these risks and the action needed to reduce and mitigate them. This will need a sustainable approach to managing rain water across the city involving all flooding, drainage and planning agencies, landowner, developers and communities across the city. New developments are required to consider flood risk from surface water, but there is much more that could be done to make this more sustainable.



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Designed by the City of Edinburgh Council Place Directorate September 2020