



Water sensitive urban design

WSUD supports climate action

Summary

Water is the primary medium through which climate change influences Earth’s ecosystem and thus the livelihood and well-being of societies (UN-Water, 2010). Global warming is likely to vary, intensify and/or accelerate the global hydrological cycle. Forecasts predict that extreme weather events such as heavy rain and drought will increase in the future; dry regions will become increasingly dry, and the wet areas will become even more humid (IPCC, 2013). Applying water sensitive urban design (WSUD) principles and practices is an effective approach for both mitigation and adaptation actions.

Introduction

In the past, water systems were designed in a linear way, i.e. sourcing, transporting, distributing, collecting, treating, and disposing water. This highly engineered approach is resource intensive and results in the fragmentation of the urban water cycle (Armitage, et al., 2014). Applying an integrated water management approach such as WSUD will help to manage the impacts of climate change on the water cycle and therefore benefit communities, the environment and be more cost-effective. The key impacts are increased temperatures and changing hydrological patterns.

Changing hydrological patterns

- affect the health of all natural ecosystems, biodiversity and the community as well as most agricultural and economic activities.
- can lead to insufficient water being available to meet demands.
- can result in reduced availability of groundwater through reduced recharge.
- put pressure on the capacity of existing drainage infrastructure and may lead to flooding.

Increased temperatures

- increases evaporation from waterbodies, and evapotranspiration from plants.
- increases temperatures within waterways and wetlands, which increases algal growth and increases heat stress and the death of aquatic organisms.
- affects the quality and availability of water supply.
- increases the urban heat island effect leading to increased water use by the community and businesses, as well as for irrigation of parks.

How WSUD supports climate action

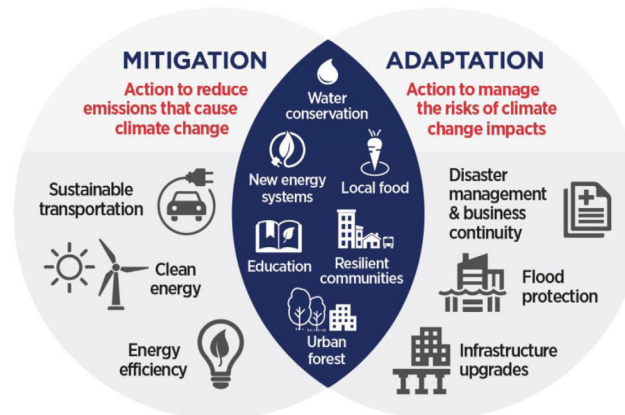


Figure 1: Examples of climate change mitigation and adaptation actions and complementary approaches (DWER, 2020)

Water sensitivity in urban environments seeks to transform cities and communities in a way that can help them to live in harmony with natural water environments while supporting the economic and social functions of urban areas. WSUD provides methods of managing the water cycle in the urban landscape and creating opportunities for the integration of

nature, which are able to both mitigate and adapt to the impacts of climate change at local and regional scales.

WSUD principles and practices include water conservation, creating urban forests and resilient communities, protecting wetlands and waterways, providing flood protection and appropriate infrastructure for future conditions and disaster management, as explained below.

Water conservation

WSUD seeks to reduce water demands within urban areas by mimicking natural hydrological processes within urban areas and creating locally representative landscapes.

By considering the total water cycle, WSUD aims to capture, store, treat, and reuse water in a manner that aligns with natural systems and optimizes use and reuse. This principle emphasises the interconnectedness of water sources, such as rainfall, groundwater, and surface water, and encourages the use of water as a valuable resource rather than a waste product through measures like rainwater and stormwater harvesting, wastewater treatment and reuse, water efficient landscaping and minimising water loss through evaporation and runoff.

Resilient communities

WSUD promotes development of integrated strategies for ecological, economic, social, and cultural sustainability. It emphasises the connections between water, vegetation, and the built environment, aiming to create sustainable and resilient communities, by providing a pathway to integrate built and natural form and character.

WSUD approaches provide urban areas with an enhanced capacity to adapt to and cope with intense rainfall events, through creating distributed storages throughout the catchment and using natural systems to manage rainfall and runoff. This promotes resilience at the local level, as well as at a catchment scale.



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WSUD approaches also seek to create sustainable landscapes and reduce long term maintenance costs. Incorporating tree-pits into streetscapes helps minimise both capital and operational costs associated with stormwater management infrastructure. In addition, shade from trees can protect roadways, therefore reducing the amount of asphalt re-seals needed over a 30-year period, thereby saving money on road maintenance (McPherson and Muchnick, 2005).

Passive irrigation interventions and permeable surfaces contribute significantly to urban cooling through soil moisture, sustaining healthy vegetation and resilient urban landscapes, while reducing run-off into the stormwater systems.

Urban forests

Urban forests have many functions that mitigate and adapt to climate change. Urban forests assist with the management of stormwater and intense events. Leaves and branches intercept rainfall and the microbial activity in the root zone helps maintain soil permeability, which enhances infiltration and the ability to cope with intense rainfall.

Vegetation in the landscape provides cooling and reduces urban heat through evapotranspiration and shade. Trees can lower the Urban Thermal Climate Index by up to 10°C, reducing heat stress from “very strong” to “strong” in a heatwave (Coutts et al, 2013), potentially saving lives.

For every dollar invested annually in tree planting and maintenance in five major cities, there was a return of \$1.37-\$3.09 based on the benefits of trees (i.e. energy savings, atmospheric CO₂ reductions, stormwater runoff reductions, etc.) (McPherson and Muchnick, 2005).

Flood protection

In natural environments, rainwater mostly evaporates, is absorbed by plants or soaks into the ground. Urbanisation dramatically changes these processes with impervious surfaces that restrict water infiltration and increase stormwater runoff. High intensity rainfall events are increasingly leading to flash flooding, while sustained, longer duration rainfall can lead to major catchment and city flooding.

WSUD provides flood protection through traditional mitigation measures, by providing stormwater detention and/or retention and reducing storm event flow volumes and rates. WSUD also promotes the safe, overland flow of stormwater and conveying larger events in natural systems. These natural systems are often more resilient to flood flows than engineered systems, particularly in extreme rainfall conditions.

Permeable paving and other WSUD practices can manage frequent rainfall events and mitigate local flood risks. Permeable pavement is an effective tool for hydrologic mitigation of storms from “every day events” up to the 10-year, 24-h average recurrence interval or 10% AEP (Fassman and Blackbourn, 2010).

Disaster management

WSUD approaches recognise the importance of preparing for and managing the impacts of climate change, such as floods, bushfires and heatwaves. This includes increasing community awareness and preparedness for disasters.

Recent events have raised the awareness of many communities to bushfire and flood risks, and there is increasing awareness of heatwaves and their impact on the community. Linking WSUD solutions to the mitigation and adaptation of these risks and events will continue to increase community support for these solutions.

All mitigation and adaptation actions

Water should be a consideration for all climate change mitigation and adaptation actions, as without it, very few of the solutions in Figure 1 are possible. Applying WSUD thinking will enhance the success of any climate action.

References

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