Climate Resilient Design & Nature Based Solutions

https://washsystemsacademy.org/mod/page/view.php?id=14797

Climate resilient WASH interventions

- **Risk-based planning** - The infrastructure, management, institutional support, and financing arrangements designed to address climate and non-climate risks, incorporating gender, social inclusion, and geographic vulnerabilities.

- **Water resources monitoring** - Continuously monitoring of hazards through measures of rainfall, stream flows, system demand, groundwater levels, water quality, and environmental degradation in the wider catchment.

- **Participatory planning with community and government** - Meaningful participation of local actors, including government and vulnerable groups, incorporating measures to strengthen climate resilience and anticipate shocks or slow-onset events into government and community plans.

Climate resilient WASH interventions – cont.

- **Well resourced, capacitated, inclusive service management** - Continuously management by a well-trained workforce with necessary support, is accessible to all regardless of social status, meets the needs of women and girls, and ensures the safety of users, including persons with disabilities and other marginalized groups

- **Appropriately designed and sited infrastructure** - Technology options that ensure continuous service access during floods and droughts, accommodate high water tables, and use risk analysis to inform infrastructure siting, with designs supporting multiple uses to prevent damage and modification.
- **Full sanitation chain functions through climate hazards** - Fecal sludge from non-sewered sanitation systems is regularly collected, safely transported, treated, and disposed of with climate hazards in mind, while wastewater from sewers is adequately treated, with adaptations protecting downstream freshwater and reducing emissions.

Climate resilient WASH interventions – cont.

- **Early warning systems** - Alerts to the public and government of impending flooding, drought, and food insecurity, with messages accessible to persons with disabilities.

- **Contingency arrangements** - Contingency plans and budgets are vital to rapidly restore WASH services during climate emergencies, ensuring accessible shelters for all.

- **Redundancy** - Extra capacity is built into service infrastructure and human resources to provide additional water supplies, additional wastewater handling and additional fecal sludge handling capabilities.

Climate resilient WASH interventions – cont.

- **Demand management** - Measures are in place to limit or ban certain water uses in times of scarcity and prioritize domestic water access, particularly for women and girls.
- **Healthy catchment and ecosystems** - Engaging in broader water resource management and catchment processes to advocate effectively for WASH, protect source areas with nature-based solutions, and fulfill sanitation responsibilities to safeguard freshwater.

Climate resilient WASH infrastructure

Modification	What the modification does	Hazard the modification responds to or mitigates
Raising	Raising the technology or critical components so they are less likely to come into contact with floodwater, groundwater, or rising sea levels	Floods, groundwater or sea-level rise
Burying	Installing the technology or its components underground so that they are less likely to come into contact with wind pressure, fire, or force of flooding	Wind pressure, fire or force of flooding
Portability	The ability of the technology to be easily moved to a new location to avoid exposure to a hazard	All forecasted hazards
No/low inputs	Technologies that require little or no inputs (e.g. electricity, water, human operators) to operate, thus reducing the need for inputs that could be exposed to hazards.	Drought, power outages, or HR deficiencies due to any hazard

Climate resilient WASH infrastructure

Modification	What the modification does	Hazard the modification responds to or mitigates
Armouring and strengthening	Hardening or stiffening the technology or its components against a hazard	Freeze/ thaw, wind, floods, earthquakes
Oversizing	Increasing the tolerance or capacity of the technology or its component so that it can accommodate extreme conditions, projected changes in conditions, or changes in the number of users	Floods; displacement/ migration
Shapes that distribute pressure	The shape of the technology creates more uniform distribution of stress over its cross-section, thus reducing the risk of failure at weaker points	Wind, floods, landslides
Circumvention	Technology materials or designs that allow wind or water to pass through so that the stress on the technology or component is reduced	Flooding

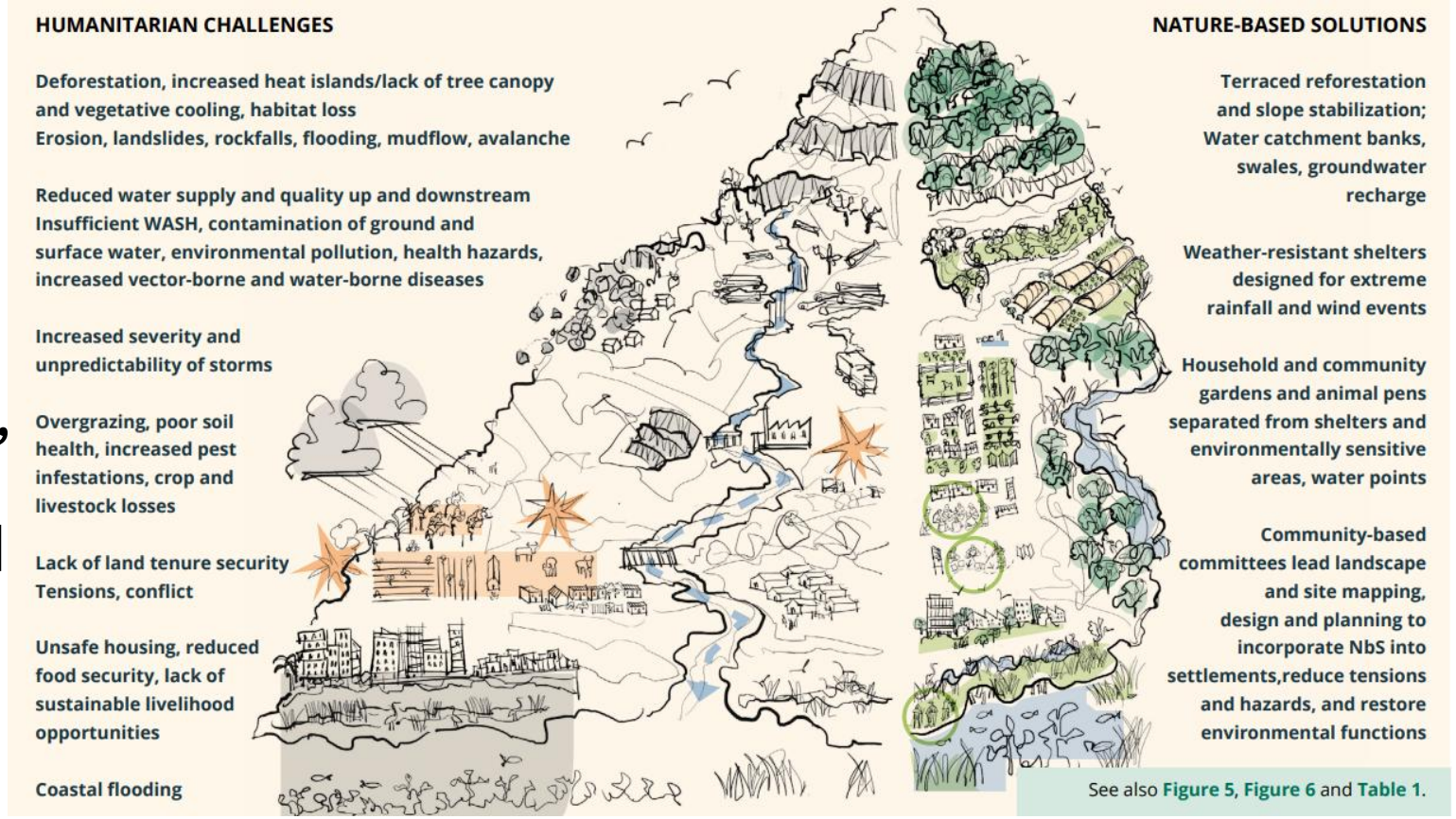
Climate resilient WASH infrastructure

Modification	What the modification does	Hazard the modification responds to or mitigates
Sealing and Barriers	Integrating seals, barriers or other forms of protection into the technology to protect critical components or processes from being disrupted by a hazard	Flooding, sea-level rise
Adaptability	The technology can be adapted or upgraded easily to function better under the changing environmental conditions (e.g. increasingly wet or increasingly dry conditions)	Floods, drought
Modular design	Additional modules can be added (plug-in type model) or removed to increase or decrease capacity of the system to accommodate variability in demand and environmental conditions	

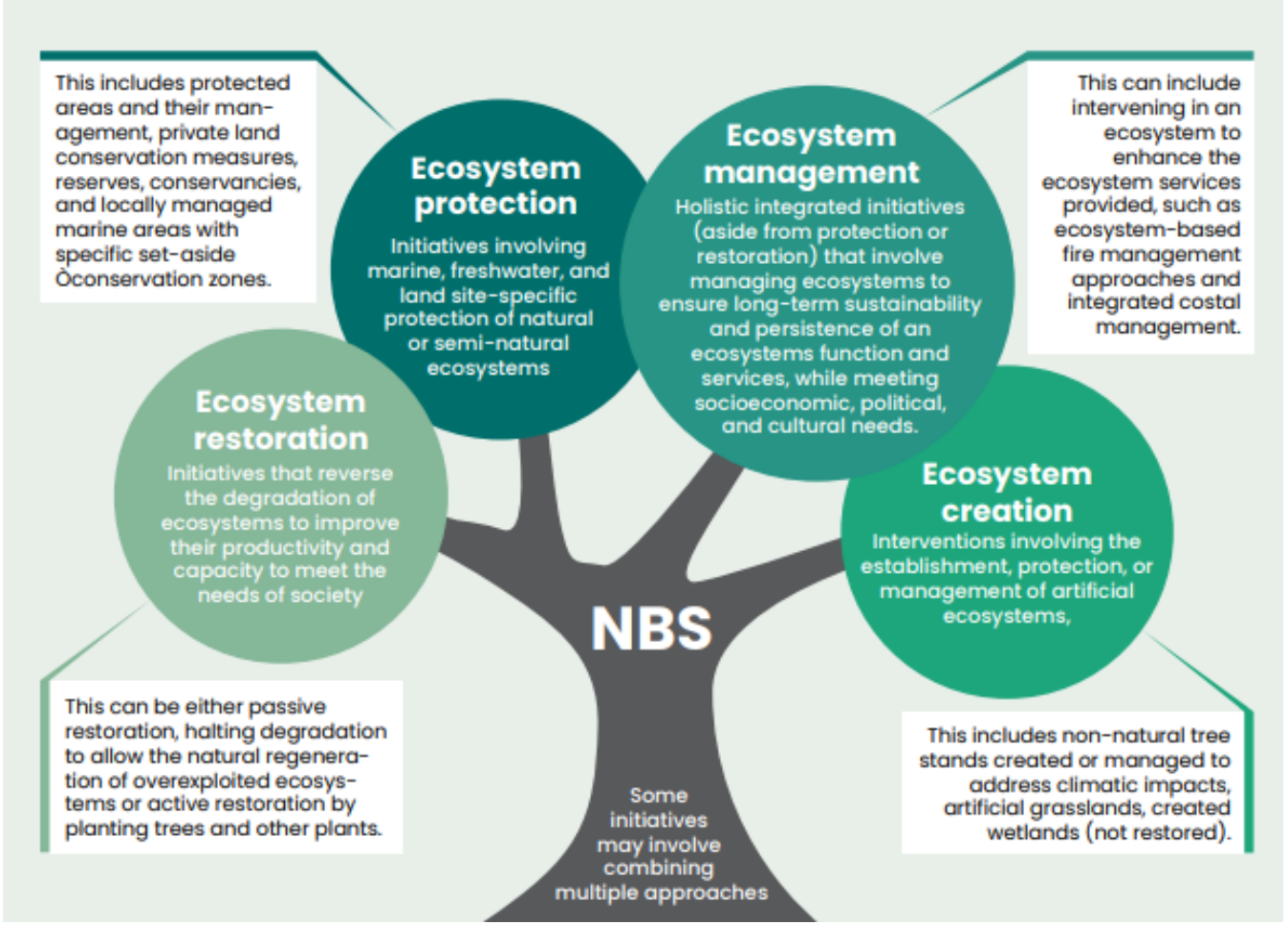
Nature based Solutions - NbS

What are NbS?

NbS are actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges simultaneously providing human well-being and biodiversity benefits



https://spherestandards.org/wp-content/uploads/Sphere-NbS-23-04-2023-english.pdf



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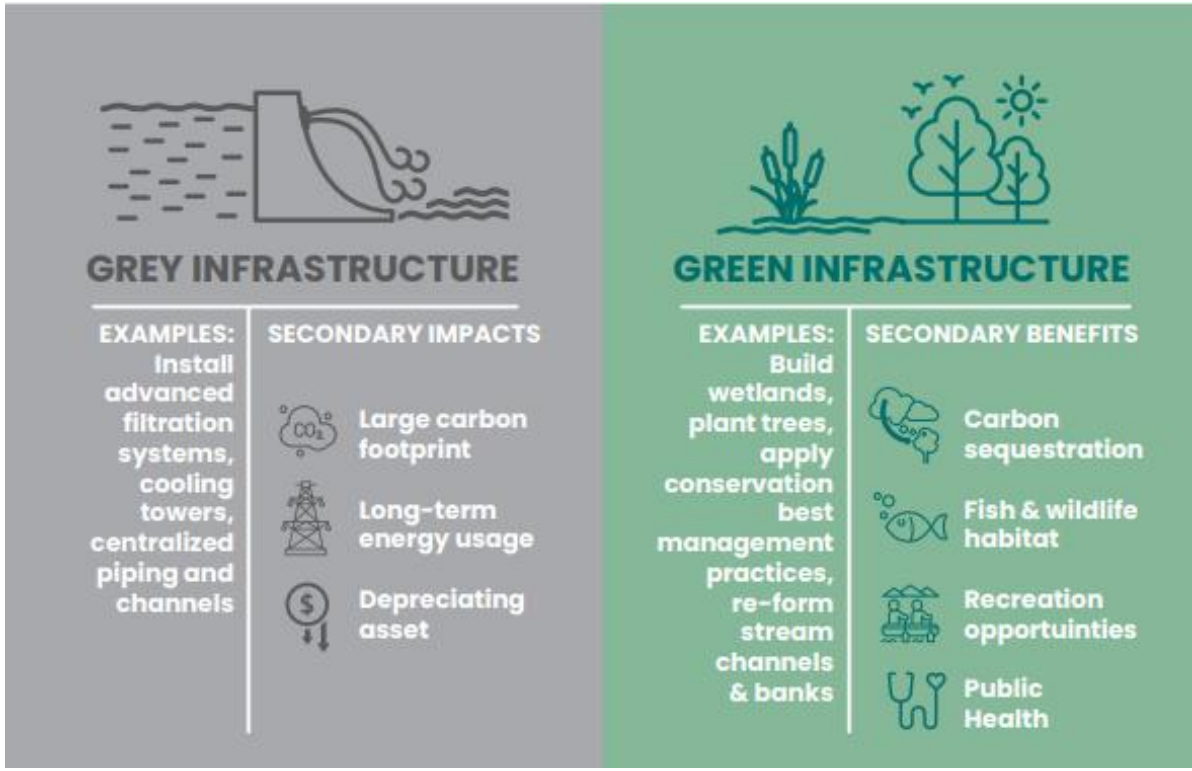

Functional Group	Water Supply		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Wetland restoration for water purification	NbS	Restoration of natural or degraded wetlands to enhance natural sedimentation, nutrient removal, and pathogen reduction. Supports raw water quality and buffers pollution pulses following extreme rainfall.	Water quality degradation; sedimentation; drought; pollution after storms
Groundwater recharge zones/ infiltration ponds	NbS	Shallow basins or infiltration structures that capture stormwater and allow it to percolate into aquifers, stabilising groundwater levels and reducing surface runoff. Must be based on hydrogeological assessment.	Drought; declining groundwater; erratic rainfall; flooding (runoff buffering)
Rainwater harvesting in displacement settings	Hybrid	Structured collection systems using roofs, gutters, and storage tanks at household or institutional level to provide supplemental water where rainfall is seasonal or irregular.	Drought; seasonal water scarcity; rainfall variability
Catchment protection for boreholes/springs	NbS	Delineation and protection of immediate and extended protection zones using vegetation, fencing, and land-use controls to reduce turbidity, contamination, and dry-season flow decline.	Drought; water quality decline; erosion; flood contamination
Riparian vegetative buffers (riverbank/ spring)	NbS	Planting of native grasses, shrubs, or trees along water abstraction points to filter sediments, stabilise banks, and reduce pollution loads during heavy rainfall events.	Erosion; flood-induced turbidity; water quality shocks

https://www.oxfamwash.org/wp-content/uploads/Guidance-Note-9-Nature-based-Solutions-to-address-Climate-Change-in-WASH.pdf

Functional Group	Water Quality & Treatment		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Slow sand filtration	Hybrid	Multi-layer sand filter where a biological layer provides high-quality microbial removal with low energy and chemical demand. Suitable for variable raw water quality.	Water quality deterioration; turbidity spikes; microbial contamination after floods
Bank filtration	NbS	Abstraction of river water indirectly through natural filtration in riverbank sediments, reducing turbidity and microbial peaks during climate-driven storm events.	Turbidity surges; microbial contamination; seasonal flow variability
Natural + chemical hybrid treatment	Hybrid	Combined treatment train using NbS (sand filtration, wetlands) to reduce solids and organics before chemical disinfection, lowering chlorine demand and improving resilience to high-turbidity floods.	Extreme turbidity; chemical shortages; climate-driven algal blooms

Functional Group	Sanitation, Hygiene & Wastewater		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Constructed wetlands	Hybrid	Engineered subsurface or vertical-flow wetlands treating greywater or wastewater through plant–microbial interactions. Maintains treatment during high rainfall events and provides buffering during surges.	Flooding; wastewater overflows; pathogen loads; heat stress (reduced treatment efficiency)
Bioswales / vegetated filtration trenches	NbS	Shallow, vegetated channels that slow and infiltrate stormwater, reducing peak flows and filtering sediments and pollutants—useful in dense settlements.	Urban flash floods; stormwater surges; erosion; pollution pulses
Composting toilets (ecosan)	NbS	Dry, urine-diverting or container-based systems converting waste into compost through aerobic treatment, eliminating groundwater contamination risks in flood-prone areas.	Flooding (avoid pit collapse); groundwater contamination; drought (no-water sanitation)
Biofiltration systems/reed beds	Hybrid	Natural filters using gravel, soil, and plants to polish greywater or effluent, especially effective after heavy rainfall–driven sediment pulses.	Pollution loads; sedimentation after storms; dry-season low flow dilution
Permeable surfaces & bioretention cells Note: this option is not detailed in the Catalogue below	Hybrid	Surfaces (gravel, permeable pavers) and depressions filled with engineered soil and plants that infiltrate stormwater and reduce runoff in camp settings.	Urban heat island; flash flooding; surface runoff peaks