GUIDANCE NOTE 9

Nature-Based Solutions to Address Climate Change in WASH

Guidance for Humanitarian Practitioners

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Abbreviations

CBWRM	Community-based water resources management
GI	Green Infrastructure
IWRM	Integrated Water Resources Management
IUCN	The International Union for Conservation of Nature
MAR	Managed Aquifer Recharge
M&E	Monitoring and Evaluation
NbS	Nature-Based Solutions
NAP	National Adaptation Plan
O&M	Operation and Maintenance

RCCE	Risk Communication and Community Engagement
RWH	Rainwater harvesting
SSF	Slow Sand Filter
UDDT	Urine Diversion Dry Toilets
UV	Ultraviolet
WASH	Water, Sanitation and Hygiene

Citation

Meek A. (2025). Nature-based solutions to address climate change in WASH. Guidance for Humanitarian Practitioners. Oxfam. Oxford.

Acknowledgements

This guidance is one of a 12-part Guidance Note series on climate change and the humanitarian WASH sector. It was developed by Oxfam and the ADAPT initiative and funded by the German Federal Foreign Office. It was written by Ashley Meek with review and contributions by Andy Bastable and Jo Trevor (Oxfam), and Larissa Miranda Heinisch (Arup UK).

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1 Introduction

Climate variability and extreme weather events, such as prolonged droughts, flash floods, and intense storms, are disrupting WASH systems worldwide (IPCC, 2022). Infrastructure damage, groundwater depletion, contamination, and altered hydrological cycles are increasingly common, especially in fragile or conflict-affected contexts. These shocks compound existing vulnerabilities by reducing water availability, increasing disease risks, and straining overstretched service networks.

As humanitarian crises become more climate-driven, WASH responses must integrate environmental and climate risk considerations into all phases of humanitarian action. Strengthening the link between risk analysis, early recovery, and sustainable resource management is critical to ensuring service continuity and resilience (Sphere Association, 2023). Nature-based Solutions (NbS) offer practical pathways for achieving this. By leveraging ecosystem functions, such as flood absorption, groundwater recharge, and natural filtration, NbS can buffer the impacts of extreme events, reduce infrastructure vulnerability, and support recovery. Interventions such as wetland restoration, soil and water conservation, and reforestation help stabilise landscapes and protect water sources, aligning humanitarian WASH with long-term resilience frameworks (IWA, 2023; IUCN, 2020).

The International Union for Conservation of Nature (IUCN) defines NbS as ‘actions to protect, sustainably manage, and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits’ (IUCN, 2020). This definition aligns closely with emerging humanitarian practice in which NbS are increasingly recognised as approaches that move beyond short-term relief and support to more durable and environmentally responsible WASH programming. The *Sphere Unpacked Guide: NbS for Climate Resilience in Humanitarian Contexts* (Sphere, 2023) identifies NbS as a core component of sustainable WASH responses and emphasises the complementarity between natural systems and engineered infrastructure.

Nature-Based Solutions offer innovative and effective approaches that work with natural systems to improve and increase the resilience of WASH services to the impacts of climate change, while supporting environmental sustainability. NbS can help improve water availability and quality, reduce disaster risks, and restore degraded environments. Examples include watershed protection to safeguard water sources, constructed wetlands for decentralised wastewater treatment, and ecological sanitation systems that improve soil health and reduce contamination.

This guidance outlines key principles, operational considerations, and practical tools for integrating NbS into humanitarian WASH interventions.

Target Audience

This guidance is designed for humanitarian WASH practitioners, including field staff, programme managers, technical advisors, and implementing partners who are planning, designing, or adapting WASH interventions that address urgent humanitarian needs while also contributing to environmental sustainability and climate resilience in contexts affected by crisis and climate change. It is also useful for donors, policymakers, and coordination platforms seeking to promote sustainability and climate resilience in humanitarian WASH responses.

Scope and Limitations

The guidance focuses on the practical integration of NbS in humanitarian WASH programming. It provides principles, examples and operational tools, and highlights linkages to humanitarian standards. However, it is not a detailed technical manual for NbS design or a comprehensive environmental management guide. Although NbS support outcomes in related sectors, such as food security, shelter, and health, they fall outside the primary scope of this guidance. Where relevant, cross-sector co-benefits are acknowledged, but detailed sectoral guidance is intentionally limited.

2 The Benefits of Nature-Based Solutions (NbS)

2.1 Key WASH outcomes

NbS support a range of beneficial outcomes in WASH programming, including:

Climate Resilience

NbS help stabilise ecosystems and reduce vulnerability to climate extremes. Restoring wetlands, forests, riparian zones, and other natural buffers can mitigate flood peaks, enhance groundwater recharge, and increase drought resilience. By supporting the natural hydrological functions that underpin water availability and quality, NbS strengthen immediate humanitarian WASH responses and longer-term adaptive capacity.

Sustainability

NbS support the continuation of essential WASH services beyond short project cycles by working with, rather than against, natural processes. Using native vegetation, protecting catchments, and restoring degraded soils reduces erosion, prevents contamination, and maintains environmental functions over time. This ensures that WASH infrastructure, such as boreholes, drainage, and sanitation systems, remains stable, accessible, and cost-effective throughout its lifespan.

Environmental and Public Health Benefits

By improving ecosystem condition, NbS can enhance water quality and reduce public health risks. Reforestation, vegetative buffers, and restored wetlands help filter contaminants, reduce sediment loads, and stabilise slopes, lowering the burden on treatment systems and reducing exposure to waterborne diseases. Health gains are particularly significant where communities rely on surface or shallow groundwater sources.

Cost-Effectiveness and Long-Term Value

Although NbS may require early investment for establishment and community engagement, they often reduce long-term operational and maintenance costs. Natural filtration, erosion control, and groundwater recharge functions decrease the need for repeated desludging, de-silting, infrastructure repairs, and chemical treatment, making NbS highly cost-effective in protracted crises or recurrent climate hazards.

2.2 Co-Benefits beyond WASH

Beyond their direct contributions to water supply, sanitation, and hygiene, NbS generate wider environmental and socio-economic gains that strengthen overall resilience and provide a powerful incentive for investment, coordination, and long-term support.

Biodiversity conservation

By restoring wetlands, riverbanks, woodlands, and other habitats, NbS help safeguard native species, improve ecological connectivity, and reverse environmental degradation. These improvements enhance ecosystem stability, which indirectly supports the reliability of WASH services over time.

Disaster risk reduction

Healthy ecosystems such as mangroves, floodplains, riparian buffers, and forested slopes act as natural protective barriers. They absorb floodwaters, reduce sediment flows, stabilise hillsides, and buffer storms, offering communities an additional layer of protection beyond engineered structures.

Livelihood enhancement

NbS can generate income opportunities through activities such as tree nurseries, erosion-control planting, wetland rehabilitation, and community stewardship of catchment areas. These actions strengthen social cohesion and can reduce pressures on natural resources by supporting more sustainable land-use practices.

Climate-change mitigation

Vegetation and soils common to many NbS options, such as reforestation, agroforestry, and wetland restoration, store carbon and contribute to emission reduction goals. These co-benefits create opportunities to link humanitarian WASH initiatives with climate finance, national adaptation plans, and broader resilience strategies.

3 Core NbS Principles, Frameworks and Approaches

3.1 International frameworks guiding NbS in humanitarian WASH

Several international frameworks are available to guide credible, effective, and sustainable Nature-Based Solutions (NbS). This section summarises the two most relevant frameworks for humanitarian WASH: the *IUCN Global Standard* (IUCN, 2020) and the *Sphere Unpacked Guide* (Sphere, 2023) and then synthesises them into practical design principles for humanitarian WASH field teams.

3.1.1 IUCN Global Standard for NbS

The IUCN is a global membership union focused on nature conservation and sustainable development. In 2020, the IUCN published the *Global Standard for NbS: A User-Friendly Framework for the Verification, Design and Scaling Up of NbS* (IUCN, 2020).

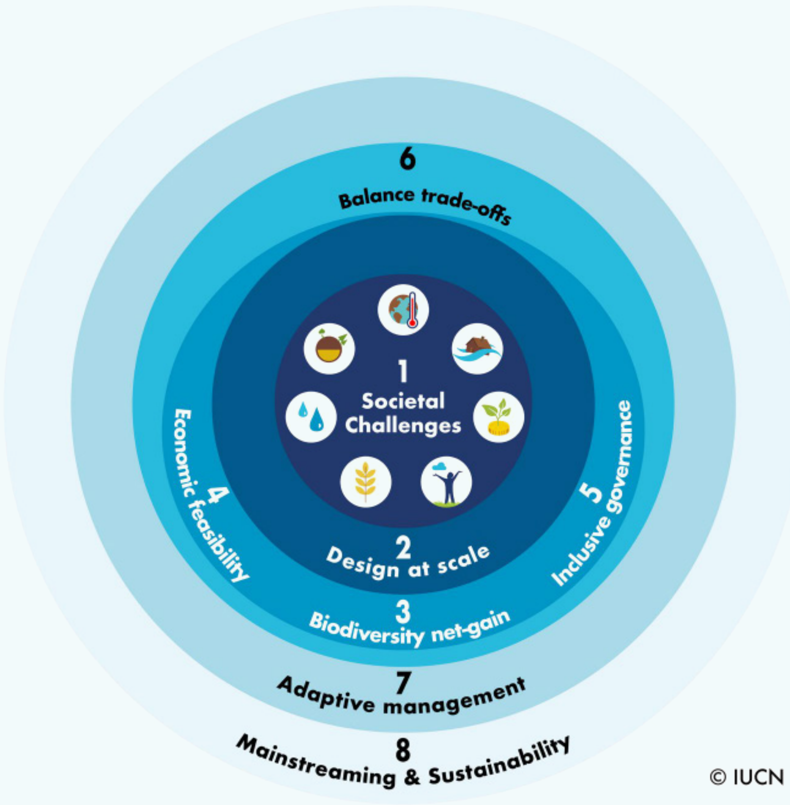
This standard sets out eight criteria that ensure NbS are effective, inclusive, sustainable, and scalable. For humanitarian WASH, these criteria provide a benchmark for ensuring that NbS both meet immediate needs and build long-term resilience.

The eight IUCN Criteria for NbS and their relevance to humanitarian WASH:

1. **Effectively address societal challenges** - NbS must be explicitly designed to solve identified challenges such as water scarcity, sanitation access, disaster risk, or climate impacts.
2. **Design at a scale that matches the challenge** – NbS should be implemented at an ecological and social scale that reflects natural system boundaries (e.g., watershed, recharge zone, slope).
3. **Achieve a net gain to biodiversity and ecosystem integrity** – NbS must enhance, rather than degrade, ecosystems supporting biodiversity, improving soil and water systems, and maintaining ecological balance.

4. **Be economically viable** – NbS should demonstrate cost-effectiveness across their life cycle, offering value through reduced maintenance costs, ecosystem services, and resilience co-benefits compared to conventional approaches.
5. **Ensure inclusive, transparent governance** – decision-making must actively engage affected communities, governments, and humanitarian actors to ensure local ownership, gender equity, and social accountability.
6. **Balance trade-offs to ensure equitable benefits** – NbS should be designed and managed to minimise adverse impacts and ensure that benefits are shared fairly among different groups, including marginalised populations.
7. **Be managed adaptively, based on evidence** – NbS require continuous monitoring and learning to adjust interventions as environmental and social conditions evolve; especially critical in dynamic humanitarian settings.
8. **Be sustainable and mainstreamed into policy and practice** – NbS must be integrated into long-term humanitarian, development, and environmental frameworks to ensure continuity, institutional learning, and scalability beyond the project cycle.

Figure 1: The eight criteria of the IUCN global standard (IUCN 2020)

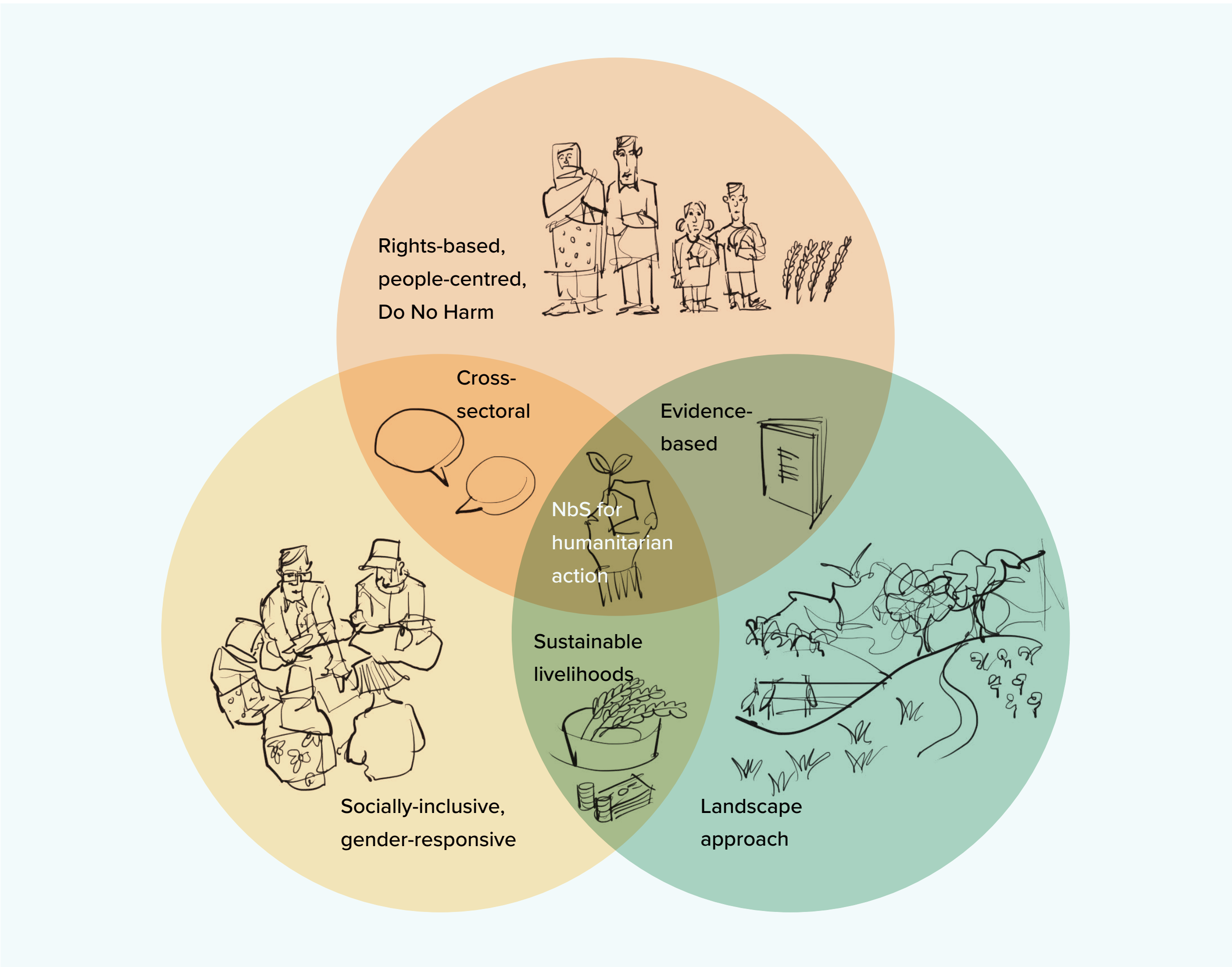


3.1.2 Sphere: integrating environmental considerations into humanitarian action

The *Sphere Unpacked Guide: NbS for Climate Resilience in Humanitarian Contexts* (Sphere, 2023) adapts global NbS principles for crisis environments, emphasising that NbS must be people-centred, inclusive, and ecologically grounded. Sphere highlights three interlinked dimensions:

- Rights-based and people-centred action.
- Social inclusion and gender responsiveness.
- Landscape approach.

Figure 2: An integrated approach for NbS in Humanitarian Action depicts three overlapping dimensions. Sphere Association (2023)



3.2 Core design principles for humanitarian NbS

Drawing from the IUCN Global Standard (IUCN, 2020), the Sphere NbS Guide (Sphere Association, 2023) and wider NbS practice, the following principles provide a conceptual foundation for how NbS should be understood and approached in humanitarian WASH.

- **Ecosystem-based approach** - implement NbS that work with nature by protecting, sustainably managing, or restoring ecosystems to deliver essential services such as water purification, flood protection, erosion control, and microclimate regulation.
- **Sustainability** - design NbS that generate long-term environmental, social, and economic benefits without compromising ecosystem integrity or the ability of future generations to meet their needs.
- **Community engagement and local ownership** - involve displaced and host communities, local authorities, and other stakeholders in the planning, implementation, and maintenance of NbS to ensure interventions are contextually appropriate, culturally relevant, and sustainable.
- **Equity and inclusion** - ensure NbS interventions are accessible and beneficial to all, including women, youth, persons with disabilities, and other marginalised groups. Equitable participation and fair distribution of benefits strengthen both effectiveness and social cohesion.
- **Institutional integration and governance** - embed NbS into humanitarian WASH planning, policy, and coordination frameworks. Strengthen local governance systems and promote multi-stakeholder partnerships for effective and scalable implementation.
- **Conflict and risk sensitivity** - assess and mitigate potential risks and conflicts related to land, resource use, or community relations. NbS should support peacebuilding and reduce competition over natural resources, particularly in displacement settings.
- **Scalability, evidence, and adaptive learning** - integrate monitoring, research, and adaptive management into NbS design and implementation. Lessons learned from pilot initiatives should inform scale-up, ensuring interventions remain flexible and evidence-based.

3.3 NbS programme approaches in humanitarian WASH

NbS programming can adopt hybrid approaches, address the needs of both displaced and host communities, and adapt to different humanitarian phases. NbS often require a blending of ecology with engineering. **Hybrid approaches** integrate NbS with conventional WASH engineering. In this guidance, hybrid refers to systems where NbS are part of the treatment or protection chain alongside conventional infrastructure (e.g., constructed wetlands plus chlorination for wastewater effluent). Hybrid systems can sometimes deliver higher treatment efficiency, structural stability, or operational control than NbS or engineering alone.

NbS can be **effectively adapted to both displacement and host-community** contexts, but their design and implementation require attention to specific challenges, such as temporary site dynamics, resource competition, and land-use pressures.

Examples of NbS in Displacement Contexts

- **Camps:** vegetated drainage ditches, natural filtration ponds, green corridors for stormwater control, ecological sanitation systems, and re-greening projects for shade and soil stability.
- **Host Communities:** reforestation or agroforestry projects to protect shared water sources, soil conservation on hillsides, and joint catchment management committees.

See the References for further information:

- **Ullal and Manoli (2024). Nature-Based Solutions in Humanitarian Settlements - Guidelines for integrating nature-based solutions in settlement planning. UNHCR:** highlight unique considerations for camp and settlement environments, including rapid site turnover, complex tenure arrangements, and the need to strengthen host-community relations.
- **Inter-Agency Standing Committee (IASC) (2023). Guidance on Environmental Responsibility in Humanitarian Operations**, which includes WASH-specific NbS examples such as bioswales, vegetative buffers, and ecological wastewater treatment in camp settings.
- **CIFOR-ICRAF (2021). Guidelines for a Landscape Approach in Displacement Settings:** for host community contexts: underlines the importance of multi-stakeholder collaboration and ecosystem restoration as entry points for peaceful coexistence and joint natural resource management.

International guidance stresses that **NbS must be adapted to different humanitarian phases** because ecosystems recover at different speeds (Sphere, 2023). Whenever possible, the design should be 'forward compatible': emergency measures that can be absorbed into recovery and long-term systems (e.g., temporary swales later deepened and vegetated as permanent bioswales).

The following phased approach supports continuity from emergency response through recovery to long-term development.

Table 1: NbS for different phases of an emergency

Phase	NbS Integration Focus
Emergency phase	*Apply rapid, low-resource NbS to stabilise services and reduce contamination.* **Examples:** temporary vegetative buffers around water points, bio-swales for stormwater diversion, rapid rainwater harvesting, natural filtration media such as sand, gravel or charcoal.
Recovery phase	*Rehabilitate and restore ecosystems to reinforce WASH infrastructure and service continuity.* **Examples:** wetland rehabilitation, infiltration ponds for recharge, modular constructed wetlands, slope reforestation to stabilise soil.
Long-term development	*Integrate NbS into wider watershed and settlement planning for sustained resilience.* **Examples:** green corridors and natural drainage networks, hybrid ecosystems + engineered systems, catchment-scale protection zones, integration into water safety planning.

4 NbS in humanitarian WASH assessment and design: a step-by-step guide

This section provides an eight-step, practical, field-ready process for assessing, designing, and implementing Nature-Based Solutions (NbS) in humanitarian WASH programmes.

Overview of the Process

Selecting the right NbS requires an understanding of the local environment and context and an assessment of whether an NbS intervention is suitable - technically feasible, socially acceptable, environmentally appropriate, financially viable, and aligned with local governance capacities. This NbS assessment and design process includes eight linked steps, from understanding the hazard context through to finalising a design package. Although presented sequentially, several steps can overlap or be repeated as new information emerges.

The guidance is focused on NbS; for a comprehensive range of all WASH adaptation options and guidance on assessing the hazards and risks, see *Guidance Note 1: Climate Change Adaptations for WASH.*

Figure 3: Natural climate solutions concept.

Source: Parradee Kietsirikul/iStock / Getty Images Plus via Getty Images

Eight-Step Process

1. **Understand the climate and hazard context** – identify priority climate hazards (see *Guidance Note 1*).

2. **Map ecosystems and natural assets** – identify wetlands, infiltration zones, riparian strips, natural drainage channels, vegetation patterns, slopes, and degraded areas that can support NbS functions using satellite imagery, field visits, and participatory mapping.

3. **Identify and shortlist candidate NbS/Hybrid options** – produce a shortlist of technically feasible interventions aligned with the local hazard profile and WASH needs.

4. **Assess feasibility and constraints** – using six suitability criteria (environmental, technical, social, economic, climate resilience, and governance), screen the shortlisted options.

5. **Co-design with stakeholders** – refine the NbS options with community members, local authorities, cluster partners, and relevant ministries, ensuring that preferences, land access issues, gender and inclusion considerations, and local knowledge inform decisions.

6. **Design for climate variability** – configure NbS to withstand extreme events, not just average conditions, incorporating appropriate vegetation, hybridisation, erosion control measures, and climate-robust sizing.

7. **Plan simple, realistic O&M** – define roles, responsibilities, and resource needs for maintenance, and agree on feasible financing and capacity-building arrangements with local actors or communities.

8. **Integrate monitoring and learning** – embed basic indicators, community-based monitoring, and feedback loops into the design so that performance data informs adjustments and supports accountability.

Each step includes objectives, indicative tasks, recommended tools, and expected outputs.

Step 1 Understand the Climate and Hazard Context

› Objective

Identify priority climate hazards, exposure pathways, humanitarian phases, whether the population is displaced or hosting, and WASH system vulnerabilities that NbS must address. This step reviews **existing** assessment and risk analysis information and does not repeat assessment guidance elsewhere in this series (see *Guidance Note 1: Climate Change Adaptations in WASH*).

› Key Tasks

- Review climate risk analyses and hazard pathways
- Identify how hazards disrupt WASH systems (e.g., erosion, turbidity shocks, drought)
- Use findings from assessments and risk analysis (see *Guidance Note 1*)
- Gather community knowledge on past hazard events (usually gathered during an assessment)

› Expected Outputs

- Rapid hazard profile
- List of WASH vulnerabilities relevant to NbS
- Identified priority hazard pathways (flooding, drought, extreme heat, etc.)

Step 2 Map Ecosystems and Natural Assets

› Objective

Identify ecological features, natural processes, and environmental assets that could support NbS functions.

› Key Tasks

- Identify wetlands, infiltration zones, slopes, and riparian buffers
- Map degraded areas requiring restoration
- Use participatory mapping (see also Participation)

› Expected Outputs

- Site-level environmental map
- Identification of NbS opportunity areas
- Description of ecological functions available at the site

Tip: Understand the local environment and select sites

Good NbS design begins with an understanding of the local hydrology, soils, vegetation, settlement patterns and hazard exposure. This aligns with the integrated landscape approach promoted in the *UNHCR NbS Settlement Guidelines* (Ullal and Manoli, 2024), which emphasises watershed-scale thinking, even in emergency contexts.

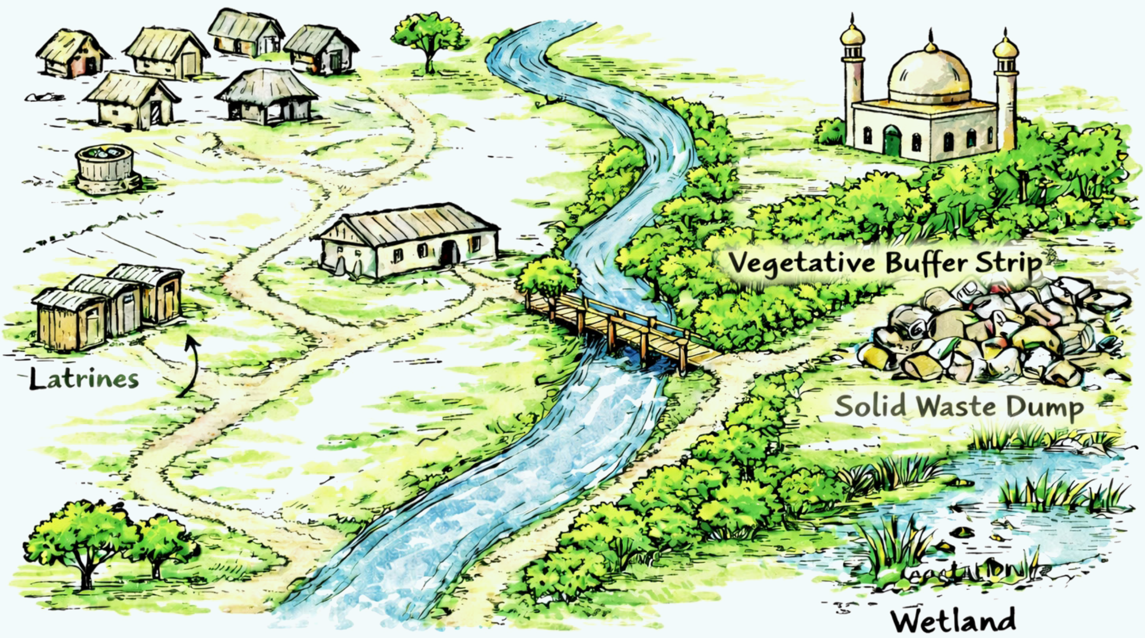
A strong site assessment integrates:

- **Watershed context:** whether the site is upstream, midstream or downstream; links to floodplains and recharge zones.
- **Soil and groundwater characteristics:** infiltration potential, soil stability, depth to water table, contamination pathways.
- **Vegetation and ecosystem health:** the presence (or absence) of native vegetation, degraded areas, riparian zones requiring rehabilitation.
- **Human settlement patterns:** density, migration or displacement patterns, areas of conflict, land tenure and access issues.

- **Exposure to climate hazards identification process outlined in** *Guidance Note 1: Climate Change Adaptations for WASH.*

Participatory mapping and community walks (WaterAid, 2021), help identify cultural sensitivities, informal drainage routes and ponding areas, locations perceived as unsafe (especially for women, girls and marginalised groups), and local priorities.

Figure 4: An illustrative example of a community map.



Source: generated by ChatGPT (2025)

Step 3 Identify and Shortlist Potential NbS Options

Combining the information from Steps 1 and 2 with the descriptions of NbS and hybrid adaptations below, create an initial shortlist of potential NbS options. The shortlist will be screened using suitability and feasibility criteria in Step 4.

› Objective

Match feasible NbS options to priority hazards and WASH objectives

› Key Tasks

- Use Table 2 to match hazards with NbS/Hybrid functions.
- Consult the quick reference guide in Table 3 to identify which NbS interventions may be appropriate for the WASH functions at risk.
- Consult Catalogue of NbS and Hybrid options for Humanitarian WASH for more details on the potential options.

› Expected Outputs

- Shortlist of NbS/hybrid options that can address the risks to WASH infrastructure and services from climate change-related hazards
- List of preliminary siting ideas
- Quick justification based on hazards and ecosystem assets

Tips

Use the NbS Options in Tables 2 and 3

Each of the NbS options listed in Tables 2 and 3 provides an initial list of solutions relevant to the hazards and WASH services affected. Use them to generate a preliminary shortlist which is then developed using the detail on each solution below in The catalogue of NbS and Hybrid Adaptations.

Tip 1: Link potential NbS options to the priority hazard(s) identified in Step 1 -
Match priority climate hazards to potential NbS/hybrid options

Table 2: Quick reference linking eight climate hazards to example NBS/Hybrid options

Climate Hazard	Likely NbS/Hybrid Options	
Flooding/heavy rainfall and storms	• *Wetland restoration* • *Riparian vegetative buffers* • *Constructed wetlands* • *Bioswales* • *Biofiltration systems* • *Vegetated buffers around waste sites*	• *Wetlands for leachate* • *Reforestation* • *Slope stabilisation* • *Green infrastructure* • *Watershed restoration*
Drought/seasonal water scarcity	• *Infiltration ponds and recharge zones* • *Rainwater harvesting* • *Catchment protection* • *Reforestation/agroforestry*	• *Soil stabilisation* • *Watershed restoration* • *Integrated WRM* • *Community-based WRM*
Heatwaves/urban heat stress	• *Rainwater harvesting (for supply buffers)* • *Green infrastructure (e.g., shaded sanitation/ handwashing structures)* • *Reforestation: urban/ peri-urban tree planting*	• *(Urban) Green infrastructure (shading, cooling)* • *Watershed restoration: landscape-scale restoration to reduce heat and dust*
Landslides/ erosion/high sediment loads	• *Catchment protection* • *Riparian vegetative buffers* • *Vegetative buffer zones: vegetation around solid waste disposal sites*	• *Reforestation and agroforestry* • *Soil stabilisation: Vetiver and native grass stabilisation* • *Watershed restoration*

Water quality shocks (post-flood contamination, pollution pulses, algal blooms)	• *Wetland restoration* • *Catchment protection* • *Riparian vegetative buffers* • *Slow sand filtration* • *Bank filtration*	• *Natural + chemical hybrid treatment* • *Constructed wetlands* • *Biofiltration/Reed beds* • *Constructed wetlands for landfill leachate*
Sea-level rise and storm surges (coastal contexts)	• *Watershed Restoration: catchment and coastal buffer restoration* • *Reforestation: shoreline planting (e.g., mangroves)*	• *Wetland restoration: coastal wetlands for surge attenuation*
Dust storms/wind erosion	• *Vegetated buffer zones* • *Reforestation*	• *Soil stabilisation: wind-break planting* • *Green infrastructure: urban/peri-urban*
Cold waves/ frost (less common in many humanitarian WASH contexts)	• *Reforestation* • *Soil stabilisation*	• *Green infrastructure: for microclimate and energy efficiency*

Tip 2: Create a shortlist, using Table 3 to link potential NbS or hybrid interventions to the functional WASH services at risk (e.g., water supplies, quality, solid waste)
- Each intervention listed is hyperlinked to the Catalogue of NbS and Hybrid options for Humanitarian WASH below, for additional details

Table 3: Quick reference menu of NbS and hybrid solution options for each functional WASH group

Note: NbS refers to ecosystem-based interventions; Hybrid combines natural and engineered elements.

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
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

Functional Group	Solid Waste		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Vegetated buffer zones around waste sites	NbS	Planting buffers around dumpsites or communal waste pits to reduce leachate migration, windblown debris, and soil erosion during intense rainfall.	Leachate overflow during storms; erosion; flood contamination
Constructed wetlands for landfill leachate	Hybrid	Wetlands designed to treat leachate from waste disposal areas, reducing pollutants mobilised by high rainfall or flood events.	Flood-driven pollution; chronic contamination during wet seasons

Functional Group	Environmental Protection & Livelihoods		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Reforestation/ agroforestry	NbS	Planting native trees and integrating crops to rebuild soil structure, enhance water infiltration, and provide diversified livelihoods for displaced and host communities.	Landslides; erosion; drought; shifting rainfall patterns
Soil stabilisation (vetiver, native grasses)	NbS	Dense-rooted grasses stabilise slopes, reduce gully formation, and protect infrastructure exposed to heavy rainfall and erosion.	Slope erosion; landslides; gully formation after heavy rains

Functional Group	Climate Adaptation & DRR		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Green infrastructure for heat and stormwater management	NbS	Shade trees, reflective vegetation, and green corridors that cool settlements and reduce heat stress, while buffering stormwater flows.	Extreme heat; drought; stormwater surges
Watershed restoration for hazard reduction	NbS	Rehabilitation of upstream ecosystems (reforestation, fire-break vegetation, erosion control) to reduce downstream flood, sediment, and drought risks.	Flooding; sedimentation; drought; wildfires

Functional Group	Water Governance & Systems Integration		
Intervention Name	**NbS or Hybrid?**	**Description**	**Climate Hazards Addressed**
Integrated Water Resources Management (IWRM)	Hybrid	Basin-wide coordination of water allocation, land-use, recharge, and environmental flows to ensure WASH interventions remain climate-compatible and conflict-sensitive.	Basin-scale water allocation stress; drought–flood cycles
Community-based Water Resources Management (WRM)	Hybrid	Local governance structures promoting water-use rules, catchment stewardship, and disaster preparedness linked to local hydro-climate variability.	Local water scarcity; land degradation; catchment erosion

Tip 3: Use the Catalogue of NbS descriptions for additional detail on each adaptation in the shortlist

- **Catalogue of NbS Descriptions by Functional Area**

  This is a practical catalogue of NbS and hybrid adaptations relevant to humanitarian WASH programming. It helps teams identify interventions that can complement, stabilise, or enhance conventional WASH systems in crisis-affected environments.

  Each intervention includes a brief technical description, typical humanitarian applications, climate hazards addressed, key design considerations, and references for further guidance.

  Using this catalogue should result in a shortlist of technically plausible NbS or hybrid options that respond to the relevant climate hazards and WASH challenges. Interventions listed here are not universal solutions; their feasibility must be confirmed through the suitability criteria in Step 4.

Catalogue of NbS Descriptions by Functional Area

Water Supply

Wetland Restoration for Water Purification

Intervention Type	NbS
Description	Restoring or rehabilitating wetlands reactivates their natural purification functions. Wetland soils, vegetation, and microbiota capture sediments, reduce turbidity, remove pathogens, and buffer nutrient and chemical pollution spikes—especially following storms and floods. In humanitarian contexts, wetlands offer a passive, low-maintenance pre-treatment step that stabilises raw water quality where infrastructure is damaged or overloaded. They also contribute to groundwater recharge and sustain dry season baseflows, increasing supply reliability.

Typical humanitarian use	Most suited to **recovery and long-term phases** where there is some predictability of site access and tenure. In protracted crises or transition settings, wetland restoration can be integrated into source protection plans or early recovery works around existing intakes.
Climate hazards addressed	• **Flooding/heavy rainfall & storms:** attenuates peak flows and reduces sediment and pollutant pulses entering surface sources. • **Drought:** enhances baseflow regulation and local groundwater–surface water interactions, sustaining water availability in dry periods. • **Water quality shocks after extremes:** provides a buffering and settling function after intense rainfall events.
Key design notes	• Needs hydrological and ecological assessment to avoid converting critical habitats or increasing vector-breeding risks. • Restoration should prioritise native species and avoid invasive plants. • Must be coupled with upstream catchment measures (e.g., erosion control) for maximum effect. • Requires clear land use agreements with authorities and communities, especially in displacement contexts.
Further resources	• Nature-based Solutions Initiative – searchable NbS case studies (filter for wetlands/water supply): • IWA Nature for Water and Sanitation – utilities using wetlands and natural treatment • Nature-based Solutions for Water Management: A Primer. UNEP-DHI (2018) Wetlands and catchment-scale NbS examples. • UNESCO (2018) *WWDR 2018:* Nature-Based Solutions for Water. Chapters on wetland restoration for water security. • Ferreira, C.S.S. et al. (2023) Wetlands as nature-based solutions for water management. *Current Opinion in Environmental Science & Health*, 33, 100476.

Groundwater Recharge Zones and Infiltration Ponds

Intervention Type	NbS
Description	Groundwater recharge interventions deliberately increase infiltration and storage of water in the subsurface through infiltration ponds, recharge basins, infiltration trenches, or managed aquifer recharge (MAR) structures; they can stabilise borehole yields and reduce pressure on shallow, climate-sensitive sources. For more information, see *Guidance Note 5: Improving the Resilience of Groundwater Infrastructure to Climate Change*.
Typical humanitarian use	Most appropriate in **recovery and transition phases**, where there is time for hydrogeological assessment and community engagement. In some contexts, **simple infiltration pits or sand dams** can be piloted as part of early recovery works.
Climate hazards addressed	• **Drought/prolonged dry spells:** increases stored groundwater and reduces dependence on highly variable surface sources. • **Heavy rainfall & storms/flooding:** helps intercept and infiltrate runoff, reducing destructive overland flows and erosion.
Key design notes	• Requires hydrogeological feasibility: unsaturated thickness, permeability, depth to water table, contamination risks. • Avoid recharge in areas with significant latrine density, waste dumps, or industrial pollution. • Should be integrated with catchment management (e.g., upstream erosion control, land-use planning) to reduce siltation of ponds. • Needs operation and maintenance arrangements (e.g., periodic de-silting, vegetation management).
Further resources	See *GN 5: Improving the Resilience of Groundwater Infrastructure to Climate Change for additional resources.* • Nature-based Solutions Initiative case studies (search ‘managed aquifer recharge’, ‘infiltration basin’). • UNESCO (2018) *WWDR 2018:* NbS for Water – sections on managed aquifer recharge and drought resilience. • UNEP-DHI (2018) Nature-based Solutions for Water Management: A Primer – infiltration and storage NbS options

Rainwater Harvesting in Displacement Settings

Intervention Type	Hybrid
Description	Rainwater harvesting (RWH) captures rainfall from roofs or prepared catchments and stores it in tanks or cisterns for later use. In displacement settings, RWH can provide decentralised, relatively low-cost supplementary supplies that reduce pressure on trucked or borehole water, particularly where rainfall is seasonal but intense. From a climate-adaptation perspective, RWH buffers short dry periods and supports contingency storage for heatwaves and supply disruptions. In humanitarian practice, systems often range from small household drums to larger institutional or communal tanks linked to health centres, schools, or distribution points. Simple pre-filtration (leaf screens, first-flush devices) and basic treatment (e.g., chlorination) are needed for safe use.
Typical humanitarian use	• **Emergency/early response:** rapidly deployable at an institutional level (clinics, schools, registration centres) with prefabricated gutters and bladder tanks. • **Recovery and protracted crises:** more permanent roof-catchment systems with fixed tanks integrated into shelter upgrades or public buildings.
Climate hazards addressed	• **Drought/seasonal water scarcity:** provides short-term storage during dry spells and reduces dependence on stressed sources. • **Heatwaves:** improves water availability for cooling, hygiene, and drinking when demand spikes. • **Heavy rainfall & storms:** captures part of intense rainfall, reducing immediate runoff pressure around shelters.
Key design notes	• Most effective where rainfall is moderate - high but seasonal; less suitable in hyper-arid zones. • Prioritise institutional roofs (schools, health posts, community centres) for larger storage, given the limited space and cost at household level. • Design for safe overflow to drainage or infiltration structures to avoid local flooding. • Ensure water quality management (first-flush, screening, cleaning of roofs/tanks and disinfection if used for drinking).

Further resources	• Oxfam (2012) Oxfam WASH Rainwater Harvesting Guidelines. • UNICEF (2019) . Guidance Note: How UNICEF Regional and Country Offices Can Shift to Climate-Resilient WASH Programming – promotes RWH as a climate-resilient option • IWA Nature for Water and Sanitation – utilities and cities using decentralised storage and RWH. • Nature-based Solutions Initiative case studies (search 'rainwater harvesting').

Catchment Protection for Boreholes and Springs

Intervention Type	NbS
Description	Catchment protection focuses on safeguarding the recharge area and surface catchment that feeds springs, boreholes, and shallow wells. Measures typically include restricting damaging land uses around sources, stabilising soils, promoting vegetative cover, and protecting riparian strips. See *Guidance Note 5: Improving the Resilience of Groundwater Infrastructure to Climate Change for more information.*
Typical humanitarian use	• **Recovery and transition phases:** once a viable source has been established and there is scope for negotiating land-use measures. • Particularly relevant in **protracted crises and return settings**, where source protection can be integrated into local development and DRR plans.
Climate hazards addressed	• **Flooding/heavy rainfall & storms:** reduces sediment and pathogen loading into springs and wells during extreme events. • **Drought:** improves infiltration and soil moisture retention, moderating yield declines in dry periods. • **Landslides/erosion:** stabilises slopes and banks around sources.
Key design notes	• Begin with **a simple hydrogeological and land-use assessment.** • Combine **'soft' measures** (by-laws, community agreements, land-use planning) and **'hard' measures** (fencing, re-vegetation, terracing, drainage). • Align with **IWRM and watershed plans** (where they exist), to avoid conflicting measures and to tap into broader funding.

Further resources	See *Guidance Note 5: Improving the Resilience of Groundwater Infrastructure to Climate Change* for useful resources. For NbS-specific resources, see: • UNEP-DHI (2018) Nature-based Solutions for Water Management: A Primer – catchment and landscape-scale NbS examples. • Nature-based Solutions Initiative case studies (search 'catchment protection', 'source protection').

Riparian Vegetative Buffers and Riverbank Stabilisation

Intervention Type	NbS
Description	Riparian buffers are strips of vegetation (trees, shrubs, grasses) along rivers, streams, and drainage channels that stabilise banks, filter pollutants, and shade water bodies. For humanitarian WASH, vegetated riverbanks can protect surface water abstraction points, river-side intakes, and informal collection sites from erosion, collapse, and contamination during extreme events. Strategically placed buffers trap sediments and faecal contamination from nearby settlements or open defecation and can reduce water-temperature extremes that affect ecology and treatment performance.
Typical humanitarian use	• **Recovery and long-term phases:** often implemented once basic services are stabilised and there is space to negotiate riverbank use and planting with communities and authorities. • In some **camp settings**, fast-growing grasses and shrubs can be used earlier as a quick riparian stabilisation measure.
Climate hazards addressed	• **Flooding/heavy rainfall & storms:** reduces bank erosion, channel widening, and turbidity peaks during extreme flows. • **Landslides and localised slope failures:** root systems reinforce soil and reduce slumping along banks. • **Drought/heatwaves:** shading reduces evaporation and thermal stress on aquatic ecosystems, supporting baseflows and water quality.

Key design notes	• Select native, non-invasive species adapted to flood regimes and local grazing pressures. • Combine buffers with set-back lines (minimum distance boundaries) for latrines, solid-waste dumps, animal enclosures, and structures near the river. • Involve communities, landowners and local authorities in planting and maintenance; consider co-benefits while avoiding over-harvesting.
Further resources	• IWA Nature for Water and Sanitation – examples of utilities using riparian restoration for water quality. • UNESCO (2018) *WWDR 2018:* NbS for Water – riparian buffer and river-basin NbS examples • UNEP-DHI (2018) Nature-based Solutions for Water Management: A Primer - measures on erosion control and riverbank stabilisation. • IFRC & WWF (2022) Working with Nature to Protect People - NbS for flood risk reduction including riverine vegetation. • McKergow, L.A. et al. (2020) NIWA. Riparian Buffer Design Guide.

Water Quality & Treatment

Slow Sand Filtration

Intervention Type	NbS
Description	Slow sand filters (SSF) use layers of graded sand and gravel through which water flows at low velocity. A biologically active layer forms on the surface and removes pathogens, organic matter, and fine suspended solids. Properly designed, SSFs can deliver high-quality drinking water with minimal energy and chemical inputs, making them well suited to low-resource, fragile or off-grid humanitarian contexts. Systems can be built at household, community or small network scale using locally available materials and simple O&M procedures.

Typical humanitarian use	• **Emergency:** small, prefabricated or locally built SSF units for small systems or institutional supplies (clinics, schools) where source water is relatively low in turbidity. • **Recovery:** community or small-town SSFs fed by protected springs, rivers, or rainwater storage to stabilise water quality as systems are rebuilt. • **Long-term:** integrated into permanent rural or small-urban water schemes as a low-cost, climate-resilient core treatment step.
Climate hazards addressed	• **Flooding & heavy rainfall/storms:** smooths out turbidity peaks and microbial contamination following storm events. • **Drought:** provides robust treatment for variable raw-water quality as sources shrink or degrade.
Key design notes	• Requires consistently low–moderate turbidity; use pre-settling or roughing filters where raw water is very turbid. • Needs careful control of flow rate and regular scraping of the top sand layer to maintain the biological layer. • Design for local O&M capacity, simple civil works, locally sourced sand and gravel, and clear cleaning procedures. • Protect the filter from direct flooding, animals and contamination; ensure secure drainage of backwash/cleaning water.
Further resources	• Oxfam (2024) Guidelines for Bulk Water Treatment in Emergencies. • Oxfam (2004) Water Filtration Equipment Manual. • UNEP-DHI Centre on Water and Environment (2018) Nature-based Solutions for Water Management: A Primer. Copenhagen: UNEP-DHI. • WaterAid (2021) London: WaterAid. Programme guidance for climate-resilient WASH. • IWA (2023) IWA Nature for Water and Sanitation

Bank Filtration

Intervention Type	NbS
Description	Bank filtration abstracts water from wells or galleries located near rivers, lakes or reservoirs, allowing water to pass through riverbank or

	lakebed sediments before collection. This natural subsurface passage attenuates pathogens, turbidity, and some chemical contaminants, providing a relatively stable raw water quality. In humanitarian or low-income small-town settings where surface water is the only source, bank filtration can reduce treatment complexity and energy needs, while improving resilience to short-term pollution spikes.
Typical humanitarian use	• **Emergency:** pilot or temporary riverbank wells to quickly improve raw-water quality where direct surface abstraction is highly turbid or contaminated. • **Recovery:** semi-permanent filter galleries developed alongside reconstruction of intakes and treatment plants. • **Long-term:** incorporated into permanent intakes for small towns or camps located near perennial rivers or lakes.
Climate hazards addressed	• **Flooding & heavy rainfall/storms:** damps down sudden turbidity and microbial peaks during and after floods. • **Drought:** can stabilise quality and temperature of water where river levels fluctuate, provided minimum flows are maintained.
Key design notes	• Requires hydraulic connection between river/lake and aquifer; carry out basic hydrogeological assessment before investing. • Maintain minimum distance and residence time in the subsurface for adequate filtration; avoid siting too close to heavily polluted reaches. • Protect abstraction wells from flooding and backflow; consider flood-proof wellheads. • Monitor water quality seasonally to detect breakthrough of contaminants during extreme events.
Further resources	• SSWM (n.d.) Bank Filtration Technology Sheet. • UN-Habitat (2018) Guideline on Riverbank Filtration in Egypt. • Gao, Y. et al. (2025). Comprehensive review of riverbank filtration, Water, 17(3), 371

Natural + Chemical Hybrid Treatment

Intervention Type	Hybrid
Description	Hybrid treatment sequenced trains combine NbS steps (such as pre-sedimentation ponds, roughing filters, reed beds, or slow sand filters)

	with conventional chemical treatment (coagulation–flocculation, disinfection). By removing a large share of suspended solids and organic matter naturally, these systems can significantly reduce chemical demand, sludge volumes, and operating costs. This is particularly relevant where climate-driven extremes create large variations in raw water turbidity or algal blooms, and where supply chains for chemicals are fragile.
Typical humanitarian use	• **Emergency:** basic pre-settling ponds or roughing filters upstream of simple chemical disinfection, where raw water is very turbid. • **Recovery:** progressive integration of wetlands, reed beds, or SSFs into temporary or semi-permanent treatment hubs. • **Long-term:** full hybrid plants for towns or protracted camps that optimise O&M costs while maintaining high water quality under variable climate conditions.
Climate hazards addressed	• **Heavy rainfall & storms/flooding:** manages extreme turbidity and pollutant pulses that would overwhelm purely engineered systems. • **Heatwaves & drought:** helps deal with algal blooms, increased organic loads and concentrating pollutants as water levels drop.
Key design notes	• Design pre-treatment (ponds, roughing filters, wetlands) to reduce turbidity and organic load before chemical dosing. • Ensure safe sludge and residuals management from both natural and chemical stages, especially in flood-prone areas. • Calibrate chemical doses under different climate conditions (high turbidity, algal blooms, low temperatures). • Keep the system modular and flexible so units can be bypassed or added as hazards and flows change.
Further resources	• Oxfam (2024) Guidelines for Bulk Water Treatment in Emergencies. • World Bank (2021) Washington, DC: World Bank Group. Nature-based solutions: a cost-effective approach for disaster risk and water resource management. • IWA (2023) Nature for water and sanitation.

Sanitation, Hygiene & Wastewater

Constructed Wetlands (Horizontal/Vertical Flow)

Intervention Type	Hybrid
Description	Constructed wetlands (horizontal or vertical flow) are shallow, lined beds filled with gravel or soil and planted with wetland vegetation. Wastewater flows through the media, where solids settle and are treated by biofilms and plant roots. They provide secondary treatment with low energy needs and can be integrated into decentralised sanitation for camps or small towns.
Typical humanitarian use	• **Emergency:** modular or prefabricated units for latrine or desludging effluent where land is available and discharge is polluting local water bodies. • **Recovery:** treatment for settlement or camp wastewater, including from communal showers and laundries. • **Long-term:** permanent decentralised treatment for refugee settlements, peri-urban neighbourhoods, or small towns transitioning from emergency to development.
Climate hazards addressed	• **Flooding/heavy rainfall:** reduces pollutant load from reaching rivers and floodplains during wet seasons. • **Drought:** facilitates safe reuse for restricted irrigation where water is scarce. • **Heatwaves:** vegetation and shallow water surfaces help buffer local heat and odour impacts.
Key design notes	• Requires proper lining and sub-surface flow to minimise mosquito breeding and odours. • Design for peak hydraulic loads during storms and potential infiltration from high groundwater. • Needs pre-treatment (screens, grease traps, settling) to avoid clogging. • Allocate sufficient land area; may not be suitable where space is extremely limited.

Further resources	• UN Habitat (2008). Constructed Wetlands Manual • Hoffmann, H. et al. (2011). GIZ: Technology Review of Constructed Wetlands. • Harvey, P. et al. (2002) WEDC. Emergency Sanitation.

Bioswales/Vegetated Filtration Trenches

Intervention Type	NbS
Description	Bioswales are shallow, vegetated channels that collect and convey stormwater while promoting infiltration and pollutant removal. In camps or dense settlements, they can replace or upgrade open drains, reducing standing water, erosion, and contamination of nearby water points.
Typical humanitarian use	• **Emergency:** rapid upgrading of **open drainage channels** to reduce stagnant water and surface contamination. • **Recovery:** incorporation into **camp layout or site upgrading**, managing runoff from latrines, bathing areas, and communal facilities. • **Long-term:** integrated into **settlement and urban planning** as part of sustainable stormwater and flood management.
Climate hazards addressed	• **Flooding/heavy rainfall & storms:** reduces peak runoff and erosion; slows and infiltrates stormwater. • **Heatwaves:** vegetation can slightly cool a microclimate in highly paved or bare areas.
Key design notes	• Requires **careful hydraulic design** (slope, cross-section) to avoid erosion or blockage. • Plant **robust, fast-growing species** tolerant of inundation and pollutants. • Include **safe disposal paths** so that extreme events can overflow without damaging shelters. • Ensure **clear operation responsibilities** for desilting and vegetation maintenance.
Further resources	• Oxfam (2008) Low Cost Drainage for Emergencies. • EPA (2021) Stormwater Best Management Practice: Grassed Swales. • NACTO (2013) Bioswales.

Composting Toilets

Intervention Type	NbS
Description	Composting toilets (ecological sanitation, EcoSan) separate and treat excreta through controlled aerobic or thermophilic composting, producing a stabilised soil amendment. See *Guidance Note 11: Climate-Resilient Faecal Sludge Management* for more information.
Typical humanitarian use	• **Emergency:** limited use where pit latrines are not feasible. • **Recovery:** pilots with strong community engagement and management, especially in rural or semi-rural displacement contexts. • **Long-term:** reuse as part of circular sanitation systems.
Climate hazards addressed	• **Flooding/high groundwater:** avoids pit collapse and excreta wash-out. • **Drought:** provides **no-water sanitation**, protecting limited water supplies. • **Landslides:** reduces destabilisation from large, saturated pits on unstable slopes.
Key design notes	• High dependence on user behaviour and maintenance. • Must follow strict safety protocols for curing time, temperature, and handling of composted material. • Needs strong social acceptability analysis: not appropriate for all contexts. • Clarify reuse pathways early, including responsibilities and legal constraints.
Further resources	See *Guidance Note 11: Climate-Resilient Faecal Sludge Management* for references and information.

Biofiltration Systems/Reed Beds

Intervention Type	Hybrid
Description	Biofiltration and reed-bed systems pass greywater or lightly contaminated wastewater through planted gravel or

	soil beds. Microorganisms attached to the media and plant roots degrade organic matter and reduce pathogens. These systems can be added as polishing steps after primary treatment or used for greywater from bathing and laundry facilities.
Typical humanitarian use	• **Emergency:** simple planted gravel beds for shower or laundry greywater in camps to reduce standing water and contamination. • **Recovery:** decentralised treatment for clustered facilities (schools, health centres, communal WASH blocks). • **Long-term:** integrated into green infrastructure for settlements, improving amenity and biodiversity while treating wastewater.
Climate hazards addressed	• **Heavy rainfall & storms/flooding:** reduces pollutant load in runoff-reaching surface water. • **Drought:** enables **safe reuse** of treated greywater for non-potable purposes (e.g., tree planting). • **Heatwaves:** increases vegetative cover and shading around dense facilities.
Key design notes	• As with constructed wetlands, ensure lining and proper gradients to prevent stagnation and mosquito breeding. • Match hydraulic loading to bed area to avoid short-circuiting and odours. • Protect from physical damage (vehicles, animals, informal pathways) in crowded camps. • Pair with behavioural messaging to prevent dumping of detergents, oils or solids that impair treatment.
Further resources	• Kabir, M.I., et al. (2020) *WPT,* Volume 15 (issue 4). Performance of a reed bed system for faecal wastewater treatment: case study • Oxfam & Arup (2019) Faecal Sludge Management for Disaster Relief. • Harvey, P. et al. (2002) Emergency Sanitation. WEDC. • Sievert, N. (2015) Guideline for the design, construction and operation of reed beds in the UAE.

Solid Waste

Vegetated Buffer Zones around Waste Sites

Intervention Type	NbS
Description	Vegetated buffer zones use bands of trees, shrubs, or grasses planted around formal or informal dumpsites to intercept windblown litter, absorb leachate, stabilise soils, and provide visual and odour screening. In flood-prone settings, they reduce the spread of solid waste and contaminants into waterways during storms.
Typical humanitarian use	• **Emergency:** rapid establishment of grass or shrub buffers downhill of temporary waste dumps near camps. • **Recovery:** planned buffer strips as part of re-organised waste collection points or transfer stations. • **Long-term:** integration into municipal landfill or controlled dumpsite design, combined with progressive closure and restoration of old waste cells.
Climate hazards addressed	• **Heavy rainfall & storms/flooding:** reduces mobilisation of waste and leachate into surface waters. • **Wind/dust storms:** limits windblown litter and dust. • **Heatwaves:** provides shading and microclimate benefits in and around waste zones.
Key design notes	• Select **deep-rooted, tolerant species** suitable for polluted soils and intermittent inundation. • Combine with **basic leachate control measures** (drainage, berms), where possible. • Ensure buffers do not **impede safe access** for waste trucks and workers. • Pair with **waste-management improvements**; buffers are not a substitute for safe waste collection and disposal.

Further resources	• Oxfam WASH (2008/2020) Domestic & Refugee Camp Waste Management. • WHO & WEDC (2011) Solid Waste Management in Emergencies. • Harvey, P. et al. (2002) Emergency Sanitation.

Constructed Wetlands for Landfill Leachate

Intervention Type	Hybrid
Description	Constructed wetlands or treatment ponds for landfill leachate use combinations of sedimentation, plant uptake, and microbial degradation to reduce pollutant loads before discharge or infiltration. In humanitarian settings where formal landfills are rare, smaller systems can treat leachate from waste cells, sludge lagoons, or combined organic waste areas.
Typical humanitarian use	• **Emergency:** limited; simple sedimentation ponds may be feasible where severe leachate problems exist. • **Recovery:** wetland or pond systems treating leachate from temporary waste disposal areas near camps or towns. • **Long-term:** incorporated into controlled landfill development and closure plans, including restoration of legacy sites.
Climate hazards addressed	• **Heavy rainfall & storms/flooding:** reduces pollutant peaks in leachate flushed from waste piles during intense rains. • **Drought:** enables some storage and controlled release rather than uncontrolled seepage.
Key design notes	• Requires careful siting and lining to avoid further contamination of groundwater. • Highly variable leachate quality; consider staged treatment (sedimentation + wetland). • Needs long-term management arrangements; not suitable where the site is likely to be abandoned quickly. • Combine with progressive closure and capping of old waste cells.
Further resources	• UN-Habitat (2008) Constructed Wetlands Manual. • UNEP (2004). Waste stabilization ponds and constructed wetlands: design manual

Environmental Protection & Livelihoods

Reforestation and Agroforestry

Intervention Type	NbS
Description	Reforestation and agroforestry interventions establish or restore tree cover—often integrating trees with crops or grazing—to stabilise soils, improve infiltration, and enhance local microclimates. In humanitarian landscapes, they can simultaneously stabilise catchments that supply WASH systems and support food, fuel, and income for displaced and host communities.
Typical humanitarian use	• **Emergency:** protection of remaining vegetation and rapid planting of protective belts near critical WASH infrastructure. • **Recovery:** joint host–displaced reforestation or agroforestry projects around water sources, hillslopes, and degraded communal land. • **Long-term:** landscape-scale programmes linking catchment restoration, livelihood support, and source protection zones.
Climate hazards addressed	• **Flooding/heavy rainfall & storms:** increases infiltration, reduces peak runoff and erosion. • **Drought/heatwaves:** improves soil moisture retention and provides shade, buffering local climate. • **Landslides:** stabilises slopes with deep root systems. • **Wildfires:** when appropriate species and management are used, can reduce uncontrolled burning by improving fuel management and alternative income options.
Key design notes	• Use **native or well-adapted species** and consider local rights and land-tenure arrangements. • Align with **landscape approaches** that involve both host and displaced communities.

	• Clarify **use rights for products** (fuelwood, fruit, fodder) to avoid conflict. • Link planting plans to **WASH priorities** (e.g., upstream of springs, around reservoirs, along riparian zones).
Further resources	• FAO (2008) Forests and Water. • UNDRR & UNEP (2022) NbS for Disaster Risk Reduction - Words in into Action. • IUCN (2016) Nature-based solutions to address global societal challenges.

Soil Stabilisation with Vetiver and Native Grasses

Intervention Type	NbS
Description	Soil stabilisation measures use deep-rooted grasses (e.g., vetiver) and native groundcover to protect exposed slopes, riverbanks, and gullies. Vegetation reduces erosion, slows runoff, and traps sediments, protecting WASH infrastructure such as latrines, access roads, and pipe crossings in steep or unstable terrain.
Typical humanitarian use	• **Emergency:** rapid stabilisation of road cuts, latrine embankments, or small slopes in high-risk areas. • **Recovery:** systematic reinforcement of gullies, riverbanks and hillsides threatening WASH or shelter infrastructure. • **Long-term:** integration into catchment rehabilitation plans and long-term DRR strategies for landslide-prone areas.
Climate hazards addressed	• **Landslides:** increases slope stability, especially when combined with physical structures (terraces, check dams). • **Heavy rainfall & storms/flooding:** reduces erosion and sedimentation that can block intakes or damage pipework. • **Drought:** some species improve soil structure and organic matter, enhancing water retention between rainfall events.

Key design notes	• Choose locally acceptable, non-invasive species; vetiver is widely used but is not universal. • Combine with simple physical structures (bunds, contour trenches) where slopes are severe. • Protect young plantings from grazing and trampling. • Link planting lines to drainage and path layouts to avoid channelling water towards shelters.
Further resources	• Grimshaw, R. & Helfer, L. (1995) Vetiver grass for soil and water conservation, land rehabilitation, and embankment stabilization. World Bank. • Marathe, D. et al. (2021) A Modified Lysimeter Study for Phyto-Treatment of Moderately Saline Wastewater Using Plant-Derived Filter Bedding Materials

Climate Adaptation & Disaster Risk Reduction

Green Infrastructure for Heat and Stormwater Management

Intervention Type	NbS
Description	Green infrastructure (GI) includes vegetated roofs, shade trees, green corridors, permeable surfaces, and small parks integrated into camp or settlement design. GI reduces surface temperatures, promotes infiltration, and manages stormwater, providing a climate-adaptation layer over basic WASH and shelter systems.
Typical humanitarian use	• **Emergency:** simple measures such as shade trees, permeable walkways, and basic bioswales around key WASH facilities. • **Recovery:** inclusion of green corridors and natural drainage in site upgrading and expansion plans. • **Long-term:** GI embedded in urban planning for protracted crises, linking DRR, health, and well-being.

Climate hazards addressed	• **Heatwaves:** reduces local heat-island effects around WASH points and shelters. • **Flooding/heavy rainfall & storms:** permeable and vegetated areas reduce runoff peaks and localised flooding. • **Dust storms:** vegetation and ground cover reduce dust generation from bare ground.
Key design notes	• Prioritise critical WASH and health facilities for shading and cooling. • Use native, drought-tolerant species and avoid water-intensive landscaping. • Combine with drainage design and solid-waste planning to avoid creating new mosquito or flooding hotspots. • Coordinate with shelter and site-planning colleagues to integrate GI into camp layout from early stages.
Further resources	• Arup & Oxfam (2019) Surface Water Management in Humanitarian Contexts. • World Bank (2017) Implementing Nature-Based Flood Protection. • IFRC & WWF (2022) Working with Nature to Protect People. • Lallemant, D. (2021) Nature-based solutions for flood risk reduction. One Earth. Volume 4, Issue 9.

Watershed Restoration for Hazard Reduction

Intervention Type	NbS
Description	Watershed restoration combines reforestation, soil and water conservation, wetland protection, and sustainable land management to reduce flood peaks, stabilise baseflows, and improve water quality. For humanitarian WASH, it shifts the focus upstream, recognising that catchment condition strongly determines the resilience of wells, springs, and surface-water abstractions to climate extremes.

Typical humanitarian use	• **Emergency:** negotiated no-cut/no-burn agreements and rapid protective measures around critical water sources. • **Recovery:** joint projects with host communities and authorities on gully rehabilitation, riparian buffers, and small retention structures. • **Long-term:** integration into national and basin-level IWRM and resilience strategies, with WASH actors participating in watershed platforms.
Climate hazards addressed	• **Flooding/heavy rainfall & storms:** reduces peak flows and erosion. • **Drought:** enhances infiltration and groundwater recharge, helping sustain dry-season flows. • **Landslides:** stabilises critical slopes. • **Wildfires:** where appropriate management is applied, reduces fuel build-up and supports more resilient landscapes.
Key design notes	• Requires multi-sector and multi-stakeholder coordination (water, environment, agriculture, local authorities). • Use climate risk and hydrological assessments to prioritise sub-catchments with highest risk to WASH assets. • Ensure rights and tenure issues are addressed to avoid conflict. • Pair with monitoring of flows, turbidity, and service continuity to demonstrate benefits.
Further resources	• UNDRR & UNEP (2022) NbS for DRR – Words into Action. • IUCN (2009) Ecosystem Approach to Disaster Risk Reduction. • FAO (2013) Forests and Water. • UNEP (2016) Coastal Partners: Applying Eco-based DRR.

Water Governance & Systems Integration

Integrated Water Resources Management (IWRM)

Intervention Type	Hybrid
Description	IWRM hybrid is a governance and planning approach that integrates NbS and engineered solutions. IWRM coordinates the management of water, land, and related resources across sectors and scales to maximise economic and social welfare without compromising ecosystems. IWRM provides NbS with a framework to link upstream catchment measures, downstream infrastructure, and multi-user demands (domestic, agriculture, environment). See *Guidance Note 2: Integrated Water Resource Management* and *Guidance Note 10: Climate Change and Community-Based Water Resources Management* for more information.
Typical humanitarian use	• **Emergency:** participate in existing basin or sub-basin discussions to understand constraints and avoid harmful abstractions. • **Recovery:** align WASH NbS projects with local water plans. • **Long-term:** advocate for humanitarian WASH systems to be integrated into national IWRM and climate-resilience strategies.
Climate hazards addressed	• **Drought and flooding cycles:** balances water allocation, storage, and environmental flows across wet and dry years. • **Heavy rainfall & storms:** encourages upstream land-use planning and NbS to moderate extremes. • **Long-term climate shifts:** supports strategic adaptation decisions (new sources, demand management, protection of critical ecosystems).
Key design notes	• Humanitarian actors should map existing water-governance structures (basin authorities, water agencies, customary systems). • Use shared climate and hydrological information to justify NbS as part of basin-wide risk reduction. • Promote inclusive representation of displaced groups in water-planning forums.

	• Link IWRM engagement to concrete field activities (e.g., protection zones, watershed restoration) to avoid purely theoretical participation.
Further resources	• GWP (2000) Integrated Water Resources Management. • Cap-Net/UNDP (2009) IWRM as a Tool for Adaptation to Climate Change. • UNEP (2009) IWRM in Action UNESCO 2009. • World Bank (2018) Water Management in Fragile Systems.

Community-Based Water Resources Management (CBWRM)

Intervention Type	Hybrid
Description	CBWRM hybrid is community-level governance integrating NbS into local water management. When CBWRM is linked to NbS, communities take an active role in protecting springs, managing small catchments, monitoring climate impacts, and deciding on trade-offs between uses. See *Guidance Note 2: Integrated Water Resource Management* and *Guidance Note 10: Climate Change and Community-Based Water Resources Management* for more information.
Typical humanitarian use	• **Emergency:** establish or support interim water committees for new settlements or camps, including both displaced and host members. • **Recovery:** build capacity for joint planning of NbS. • **Long-term:** transition from externally supported systems to locally led governance, embedded in municipal or customary structures.
Climate hazards addressed	• **Drought:** supports local rules and community monitoring, fair allocation and demand management, and community protection of critical sources. • **Flooding/heavy rainfall & storms:** community-organised maintenance of drainage, buffers, and NbS assets reduces damage to WASH systems. • **Slow-onset change (shifting seasons, groundwater decline):** local observations and action feed into adaptive management and advocacy to higher levels.

Key design notes	• Ensure inclusive representation (gender, age, disability, displaced/host). • Provide practical training on NbS operation and maintenance. • Link community plans to district or basin-level processes. • Support simple monitoring tools (rain gauges, source-flow logs, water-quality spot checks) to strengthen local evidence.
Further resources	See *GN 10 Climate Change and Community-Based Water Resources Management* and: • Oxfam WASH (2009) Introduction to Community-Based Water Resource Management. • Oxfam, ICE, WaterAid (2010) Managing Water Locally. • Day, S. (2009). Community-based water resources management. *Waterlines*, 28(2), pp. 149–163

Step 4 Assess Feasibility and Constraints

Through Steps 1, 2 and 3, a shortlist of WASH NbS options for the local context and hazards will have been generated. This list needs refining and screening against additional criteria, such as the population characteristics and the ecology and economy of the area. The outcome is a transparent justification of which options are taken forward and which are excluded.

› Objective

Evaluate the shortlisted NsB interventions using the feasibility and suitability criteria below.

› Key Tasks

- Apply the six suitability criteria below (environmental, technical, social, economic, climate resilience, governance).
- Apply the indications on when NbS are suitable or less suitable.
- Review information from Steps 1 and 2 on land tenure, population density and ecological degradation.

› Expected Outputs

- Feasibility matrix
- Eliminated options with reasons
- Final shortlist for co-design with the communities

Tips

Suitability criteria

Humanitarian NbS should be screened against six core suitability criteria linked to international frameworks (IUCN Global Standard, Sphere NbS Guide):

1. **Environmental feasibility** – are hydrology, soils, vegetation and ecological conditions adequate for this NbS?
2. **Technical performance & reliability** – can the intervention deliver dependable service under crisis constraints?

3. **Social & cultural acceptability** – is the NbS option compatible with local practices, power dynamics, land access and community preferences?

4. **Economic viability** – are materials, labour and long-term O&M realistic? How does it compare to conventional engineered alternatives over time?

5. **Climate resilience contribution** – does the intervention clearly reduce priority hazards identified using *Guidance Note 1: Climate Change Adaptations for WASH* (e.g., floods, drought, storms, heatwaves)?

6. **Governance & capacity alignment** – are there institutions, community groups and partners who can own, operate and maintain the NbS, and is it consistent with existing policies and plans?

When NbS are suitable in humanitarian WASH

NbS are most appropriate when:

- Some land or ecological space is available (e.g., roadside verges, riparian buffers, low-lying areas unsuitable for shelters).
- Local vegetation can survive under anticipated climatic extremes or can be supported during establishment.
- Hydrological conditions (e.g., seasonal flows, groundwater responses) support the desired natural processes.
- Communities value, or are willing to restore, natural features such as wetlands, riparian areas, or woodlots.
- The expected lifespan of the site or settlement justifies investment in systems that may take months or years to mature.
- Long-term partners (municipalities, basin authorities, NGOs, CBOs) can eventually take over management responsibilities.
- Hybrid solutions can be used where a purely NbS option would not reliably meet humanitarian standards.

NbS may be less suitable when:

- Land tenure is highly contested or unclear, and there is no realistic pathway to negotiated use.

- The ecological base is so degraded that restoration to functional levels would take longer than the expected lifespan of the site.
- Climatic extremes exceed the buffering capacity of nature alone (e.g., very intense flash flooding), requiring engineered measures for safety.
- Outbreak control or acute contamination requires immediate engineered measures.
- Population density severely restricts space for vegetation, infiltration or safe flood pathways.

In such cases, priority should be given to immediate risk reduction measures, with NbS considered only where they can safely complement engineered controls.

Tools for assessing suitability

A list of useful Environmental and climate tools, Ecosystem and landcover tools, field tests and social tools is included in Annexe 1.

Step 5 Co-design Solutions with Stakeholders

The final list of potential NbS, screened for suitability in Step 4, can now be developed and finalised with the community and translated into site selection, design preferences and agreed roles and responsibilities for implementation.

› Objective

Refine options through inclusive, participatory processes involving communities and institutional stakeholders.

› Key Tasks

- Conduct participatory mapping and site walks.
- Ensure decisions reflect gender, disability, and social inclusion considerations.
- Involve authorities and cluster mechanisms.
- Integrate traditional and indigenous knowledge.

› Expected Outputs

- Community-validated NbS options
- Agreed sites and design preferences
- Documented roles and responsibilities

Tips

Participation

Participation ensures that affected people have influence over decisions that impact their environment, safety and access to services. When participation is meaningful, it allows communities to co-design interventions so that NbS reflect daily routines, cultural norms and local settlement patterns. Participation also includes building the capacity of local institutions and community groups so they can take an active role in NbS decision-making, management and monitoring. Through training and shared planning, participation shifts communities from passive recipients to informed actors shaping the systems that affect them.

Community engagement

Community engagement is the practical interaction between implementing agencies and communities throughout the NbS project cycle.

- **Participatory planning**
  - Engage both displaced and host populations in identifying problems, selecting NbS options and choosing sites.
  - Use participatory mapping, transect walks, drainage route identification, and seasonal calendars.
- **Local community leadership**
  - Treat community members as stewards—never passive beneficiaries.
  - Strengthen existing structures (water committees, women's groups, youth groups) or establish NbS-focused groups if needed.
- **Indigenous and traditional knowledge integration**
  - Where relevant, integrate local ecological knowledge, such as soil conservation techniques, agroforestry practices, or traditional watershed management.
  - Ensure engagement respects rights, cultural norms and FPIC (Free, Prior and Informed Consent).
- **Trust-building and communication**
  - Maintain regular, transparent communication about purpose, timelines, trade-offs, and expected benefits of NbS.
  - Provide updates during construction and after handover to ensure ongoing trust.

Community engagement builds ownership, reduces the risk of misuse or neglect, and improves long-term performance of NbS.

See also *GN 3: Climate Change Adaptation for Hygiene Promotion, Vector Control, Outbreak Preparedness and WASH in Health Facilities* and *GN 6: Risk Communication and Community Engagement Strategies for Climate Change Adaptation in WASH Programming*.

Step 6 Design for Climate Variability and Stressors

› Objective

Develop climate-robust NbS that function under extreme conditions.

› Key Tasks

- Size systems based on peak flows and drought scenarios (see *Guidance Note 1: Climate Change Adaptations for WASH*).
- Integrate hybrid elements where needed.
- Select climate-resilient native vegetation.
- Produce simple technical drawings and Bill of Quantities.

› Expected Outputs

- Technical design package
- Planting and materials plan
- Climate stress-test summary

Step 7 Plan Simple, Realistic Operation and Maintenance (O&M)

› Objective

Ensure that the NbS can be maintained by communities, authorities, or partners after installation.

› Key Tasks

- Define maintenance tasks and responsible actors.
- Identify training and capacity-building needs.
- Estimate long-term costs and resource requirements (See Section 5 on Financing).
- Align with existing community or municipal structures (see Section 5 on Governance).

› Expected Outputs

- O&M plan with responsibilities
- Maintenance schedule
- Capacity-building plan
- Handover arrangements where relevant

Step 8 Integrate Monitoring, Learning, and Adaptive Management

Monitoring, Evidence, and Learning

NbS performance depends on tracking environmental and social changes over time. Incorporating monitoring and adaptive management into project design allows teams to refine interventions based on evidence, respond to ecosystem shifts, and demonstrate measurable improvements in WASH outcomes. Strengthening learning systems also supports the wider adoption of effective NbS models across the sector.

› Objective

Create a MEAL system that tracks NbS performance and supports adaptive management.

› Key Tasks

- Select simple indicators based on categories below (environmental, social, economic).
- Integrate NbS indicators into existing MEAL systems.
- Conduct baseline measurements.
- Establish feedback loops between field teams, communities, and authorities.

› Expected Outputs

- NbS monitoring plan
- Baseline dataset
- Community-based monitoring roles
- Lessons learned log and adaptation notes

Tips

Indicators for NbS effectiveness

- **Environmental indicators**
  - Water quality (e.g., turbidity, E. coli, nutrients) upstream and downstream of NbS
  - Biodiversity and vegetation (e.g., species richness, canopy cover, survival rates)
  - Ecosystem condition (e.g., erosion rates, slope stability, flood extent and duration)
- **Social indicators (with Gender Equality, Disability, and Social Inclusion (GEDSI) considerations)**
  - Community satisfaction and acceptance of NbS and surrounding WASH services
  - Changes in safe and dignified access to water and sanitation, including for women, girls, persons with disabilities and marginalised groups
  - Protection-related outcomes (e.g., safer pathways to facilities, reduced flooding around shelters)
  - Health outcomes, where feasible (e.g., self-reported reductions in waterborne disease)
  - Equity and inclusion outcomes, such as whether NbS reduce barriers, distribute benefits fairly, and avoid disproportionate labour or safety burdens for specific groups
- **Economic indicators**
  - Cost savings compared to traditional infrastructure over time
  - Livelihood improvements (e.g., income from nurseries, reduced time collecting water or fuelwood)
  - Economic benefits from ecosystem services, where valuation has been undertaken

Adaptive management and continuous learning

- **Feedback loops into decision-making**
  - Establish clear processes so that monitoring results and community feedback are regularly reviewed by project teams and community representatives, and used to adjust designs, operations or siting as needed.
- **Capacity building**
  - Train staff and community members in basic NbS monitoring techniques, data interpretation and use of findings. This can be combined with broader climate-resilient WASH and environmental training.
- **Knowledge sharing and exchange**
  - Document lessons (including what did *not* work as expected) and share them through:
    - ✓ internal learning sessions
    - ✓ inter-agency or cluster meetings
    - ✓ global NbS and WASH platforms (such as PANORAMA, CitiesWithNature, NbS Initiative)
    - ✓ Encourage peer-to-peer exchange visits where feasible, allowing communities and field staff to see NbS in other contexts and adapt practical ideas

5 Enabling Conditions for Successful NbS in Humanitarian WASH

Successful NbS in humanitarian WASH often depend less on technical design and more on whether people, institutions and systems are in place to support them over time. This section brings together four pillars that enable NbS to work in practice:

- Governance, participation and community engagement
- Strategic partnerships and coordination
- Policy and legal frameworks
- Financing and resource mobilisation

Monitoring, Learning and Adaptive Management is a further enabling approach for successful NbS. It is covered in Step 8 above.

5.1 Governance

Good governance provides the institutional foundation that enables NbS to function beyond the immediate humanitarian timeline. It clarifies who has authority over land, water, and environmental management. It ensures that NbS decisions are made and endorsed by legitimate actors, whether municipal authorities, customary landholders, basin organisations, or camp management structures. Governance also defines who is responsible for each part of the NbS lifecycle, from planning and construction to long-term maintenance and oversight. When these responsibilities are explicit, ideally formalised through agreements or integration into local plans, NbS benefit from continuity even as humanitarian actors transition out. Effective governance further includes transparent accountability mechanisms through which users can report issues, request repairs and raise concerns about land or resource access. This clarity and accountability reduce conflict risks and support the long-term sustainability of NbS.

Participation, Equity, Inclusion and Local Ownership

NbS are more effective and durable when communities, both displaced and host, shape decisions about site selection, design, and maintenance. Meaningful participation ensures that interventions reflect local priorities, cultural practices, and traditional ecological knowledge. Integrating gender, protection, disability, and social inclusion considerations into these processes helps ensure fair access to resources, reduces safety risks, and prevents NbS from unintentionally reinforcing existing inequalities. See also: Step 5: Co-design Solutions with Stakeholders above.

5.2 Strategic Partnerships

NbS are inherently cross-sectoral: they link water, environment, land use, agriculture, urban planning and disaster risk reduction. Humanitarian agencies rarely hold all the skills or mandates needed and must therefore work in partnership.

Key partnership dimensions include:

- **Collaborative stakeholder platforms**

  Work with environmental authorities, water resource agencies, forestry and agriculture departments, municipalities, NGOs, research institutions and community-based organisations to pool expertise, datasets and mandates.

- **Humanitarian coordination mechanisms**

  Engage with relevant coordination structures (e.g., WASH, Shelter and CCCM clusters, environmental working groups) to:

  - avoid duplication and conflicting land uses
  - identify opportunities to link NbS with shelter/site planning or solid waste management
  - share lessons across agencies and responses

- **Role clarity and agreements**

  Where NbS are expected to outlast the humanitarian phase, define who will take over the long-term responsibility (e.g., municipalities, basin organisations, local NGOs) and formalise this where possible through MoUs, agreements or inclusion in local plans.

- **Scalability and Replicability**

  Successful NbS are adaptable across diverse humanitarian contexts and can be scaled-up when integrated into coordination mechanisms, government planning systems, and donor frameworks. Documenting designs, materials, and maintenance roles helps other actors replicate interventions, enabling NbS to evolve from isolated pilots into standard components of climate-smart WASH programming.

5.3 Policy and Legal Considerations

NbS in humanitarian WASH must operate within national and local laws.

Key steps include:

- **Regulatory compliance**
  - Check whether proposed NbS sites intersect with protected areas, riparian reserves, wetlands, forest lands, or zones with specific planning restrictions.
  - Clarify requirements for environmental impact assessments, land-use permits or construction approvals.
- **Alignment with existing plans and strategies**
  - Align NbS with watershed plans, municipal development plans, Nationally Determined Contributions, National Adaptation Plans (NAPs) and sectoral climate strategies where these exist.
  - Where settlements are expected to become longer-term, ensure NbS are visible in urban or settlement masterplans.
- **Advocacy for enabling frameworks**
  - Where gaps or obstacles exist, humanitarian actors can document NbS results and support evidence-based advocacy to integrate NbS into policy and response frameworks.

5.4 Financing and Resource Mobilisation for NbS in Humanitarian WASH

Implementing NbS requires both appropriate funding sources and realistic costing. While NbS can be highly cost-effective over time, they still require investment in design, establishment and early maintenance.

1. Funding sources

Potential sources of finance include:

- **Climate funds**

  Global funds such as the Green Climate Fund, Global Environment Facility and Adaptation Fund support projects that combine climate resilience, ecosystem restoration and improved water security.

- **Humanitarian donors**

  Governments and multilateral humanitarian donors increasingly recognise NbS as part of climate-smart humanitarian action and are beginning to fund pilots and scale-up within emergency, anticipatory action and protracted crisis portfolios.

- **Development partners and multilateral banks**

  Development finance institutions may support NbS as part of water, urban resilience or social cohesion programmes, especially where NbS help bridge humanitarian and development objectives.

- **Green financing and impact investment**

  Instruments such as green bonds, blended finance and impact investments can be leveraged where NbS provide measurable environmental and social benefits and where long-term partners (e.g., utilities, municipalities) are in place.

2. Costing models for NbS

NbS should be appraised using life cycle thinking rather than only upfront capital costs:

- **Initial investment vs. long-term savings**

  NbS may have higher planning and establishment costs (e.g., site assessments, planting, early maintenance), but can reduce long-term O&M costs, extend asset life and reduce damage from floods, erosion or contamination.

- **Valuing ecosystem services**

  Assigning indicative monetary values to services such as water purification, flood attenuation, microclimate regulation and carbon sequestration strengthens the financial case for NbS. Tools such as InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) can support scenario analysis and valuation where data and capacity allow.

- **Cost–benefit and cost-effectiveness analysis**

  Comparing NbS and hybrid options with conventional grey infrastructure - considering both direct costs and avoided losses - helps demonstrate economic advantages and can be a powerful tool for donor engagement.

3. Scaling up NbS in funding cycles

To move beyond isolated pilots, NbS need to be embedded in standard humanitarian and nexus processes:

- **Mainstreaming NbS in plans and proposals**

  Systematically consider NbS within WASH strategies, Humanitarian Response Plans, contingency plans, and project templates so that they become part of the 'default' option set rather than special add-ons.

- **Demonstrating impact and sharing evidence**

  Document and share credible evidence of NbS performance (e.g., reduced flood depth, improved water quality, user satisfaction, and avoided damages). Online platforms such as PANORAMA – Solutions for a Healthy Planet, the NbS Initiative case study platform, and CitiesWithNature can be used to upload, compare and disseminate case studies

- **Building multi-actor partnerships for scale**

  Work with governments, NGOs, communities and private sector actors to co-finance and co-manage NbS, aligning humanitarian investments with longer-term public or blended finance.

By finding the right funds, planning costs carefully and building strong partnerships, humanitarian WASH programmes can secure the resources needed to implement and grow NbS at a meaningful scale.

When enabling conditions that determine whether NbS can deliver resilient, inclusive WASH services over time are deliberately planned alongside technical design, NbS can become a credible, scalable part of humanitarian and nexus WASH programming.

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Annexe 1: Tools for Assessing the Suitability of NbS options

Environmental and climate tools

- Nexus Environmental Assessment Tool Plus (NEAT+) – a rapid project-level environmental screening tool developed by the UNEP/OCHA Joint Environment Unit (JEU) and partners. It flags ecosystem sensitivities, land-use pressures, water stress, pollution pathways and deforestation that influence NbS opportunities.
- **Global Water Partnership/UNICEF climate-resilient WASH portal (with tools, modules, and resources):** national or programme-level frameworks and risk assessment tools for climate-resilient WASH, which combine hazard, exposure, vulnerability and capacity to prioritise climate risks relevant to WASH systems: https://www.gwp.org/en/washclimateresilience;
- **WASH Climate Resilient Development. Guidance Note. Risk Assessments for WASH. UNICEF and GWP (2017)** - https://www.gwp.org/globalassets/global/toolbox/publications/technical-briefs/gwp_unicef_guidance-note-risk-assessments-for-wash.pdf
- **Global WASH Cluster: Climate Change & WASH Toolbox for Humanitarian Practitioners (2024)** – an online toolbox that brings together hazard–impact pathways, training materials, and tools to integrate climate risks into humanitarian WASH, including NbS use-cases. https://www.washcluster.net/Climate_Change_and_WASH_Toolbox

Ecosystem and land-cover tools

- **FAO land cover datasets (e.g., GLC-SHARE)** – global land cover databases that help identify vegetation types, cropland, built-up areas and other land-cover classes relevant for NbS siting. https://www.fao.org/land-water/land/land-governance/land-resources-planning-toolbox/category/details/en/c/1036355/
- **Copernicus Land Monitoring Service** – free global land-cover and land-use layers, plus a web-based data viewer for mapping wetlands, floodplains, riparian zones, forest cover and urban expansion. https://www.copernicus.eu/en/services/land
- **Google Earth/Earth Engine** – high-resolution satellite imagery and simple mapping tools to identify drainage paths, erosion hotspots, informal waste dumping and settlement growth. https://earth.google.com; https://earthengine.google.com

Field tests and social tools

- **Simple hydrological field tests** – infiltration tests, groundwater level checks, and basic flow measurements can quickly determine whether infiltration ponds, bioswales, buffer strips or recharge zones are realistic.
- **Community consultations and participatory mapping** – co-produced maps - reveal land values, sites people avoid (e.g., burial grounds, contested land), informal drainage routes and protection concerns. These processes are highly recommended in climate-resilient WASH guidance.

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