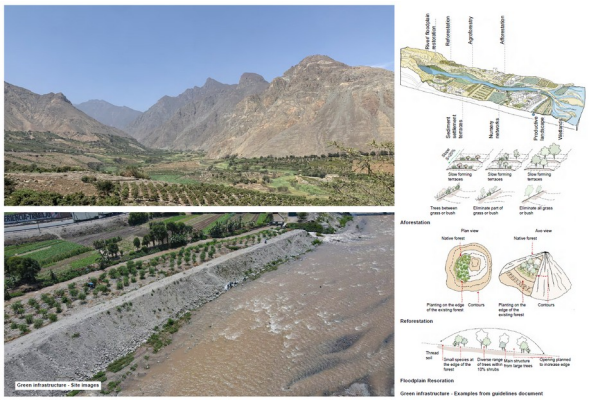
Peru Reconstruction Programme – Delivering Nature-based Solutions in Peru
Submitted by Arup

Awards category
Catchment based SuDS solutions



Lead or collaborating organisation(s)	**UK Delivery Team (UKDT: Arup, Mace, Gleeds)**
Location of SuDS	Peru (Country Wide)

1. SuDS overview

SuDS components used	• Swales • Detention basins and retention ponds • Wetlands • Tree pits • Rain gardens • Floodable parks • Permeable paving • *Xeriscapes* • *Afforestation/ reforestation* • *Re-naturalised rivers* • *Floodable areas* • *Riverside vegetation* • *Gully control* • *Infiltration channels*
Size of the scheme and its local context	SuDS for 7 urban towns, as well as the delivery of NAI for 13 catchment areas and flood defence for 17 river basins.
Approximate age of scheme (years)	2020 - ongoing

Benefits of the scheme	• Provides catchment wide design solutions (from upper catchment to lower catchment by the coast) using natural infrastructure (NAI), SuDS and Nature-based Solutions (NbS). • Manages local and catchment wide flooding and sediment movement, in turn this will mitigate the impact and destruction that occurs in Peru during El Nino Phenomenon (ENP). • In 2017, precipitation and increased river flows caused the destruction of key infrastructure including bridges and roads affecting 1.9million Peruvians. ENP also caused 198 deaths, displaced 194,000 people and left 65,000 homes inhabitable (Yglesias et al, 2023). The Peru Reconstruction Programme project seeks to ensure this damage is mitigated. • Applies an integrated approach to urban storm-water drainage management. • Protects and enhances the urban water cycle. • Identifies and provides various social, economic and environmental benefits through the introduction of NAI (refer to benefits wheel). • Facilitates community involvement in the delivery of solutions. • Creates a sense of place and identifies, improves and/or provides new public spaces. • Considers a holistic and collaborative design-led outcomes through a system thinking approach. • Creates a cost-effective sustainable solution (for example, re-using of materials, soil improvements, carbon sequestration). • Upskill central and local government knowledge as well as the various project contractors and design team • Provides long term management and maintenance plan for the success of the various interventions as well as a governance plan.

Briefly describe the scheme	Following the devastating 2017 El Niño climate cycle, the UK Department for International Trade collaborated with the Government of Peru in June 2020 to reconstruct urban drainage systems, schools, health facilities, and flood protection. The UKDT Mace, Arup and Gleeds, worked in partnership with the client, local designers, and contractors on the reconstruction of a $5 billion portfolio of urban drainage systems, schools, hospitals, and flood protection. Despite being one of the world's most biodiverse countries, Peru faces heightened vulnerability to climate change impacts, including natural disasters like earthquakes, floods, landslides, and droughts. The El Niño Phenomenon exacerbates these events, with climate change intensifying their frequency and severity. Compounded by existing challenges such as deforestation, water pollution, and poor land use management, these climate risks imperil Peru's future development. The UKDT facilitated technical assurance through design workshops, engagement with local experts, site visits, and the formulation of a suite of design guidelines. A comprehensive document outlining design guidelines was created to offer practical technical guidance, emphasizing design principles, benefits, implementation and management and maintenance toolkit of various Suds interventions and crucial coordination for the effective implementation of NbS in an arid urban drainage design. The suite of guidance provides a holistic overview on how to infiltrate, store and slow water release to natural rivers at catchment wide and urban scales.

2. SuDS details

No.	Question	Answer
1	What difference has this scheme made to the local community or area?	The suite of design guidelines provides knowledge to national and local government, designers, and contractors on the what, why and how to design with SuDS and NAI as a cost-effective, resilient, long-term solution. Using this tool, will reduce the devastating impacts of ENP and provide security for 6% of Peru population affected during this event. This design approach allows better water infiltration and storage, creates new local parks in cities whilst at catchment level, reforestation schemes will provide employment opportunities during the construction and maintenance of the projects. Ensuring resilient cities allows for planned future urban growth in these impoverish cities.

2	What is exceptional about this scheme beyond a standard approach?	• This is a national project and at scale larger than anything seen before in the UK. • It considers the design solutions for the ENP extreme weather conditions. • Integrates possible design solutions and considerations at all scales of a catchment from the cities to forest in the upper catchment to deserts by the coast. • Provides a design solution to remove the cumulative effect of water movement and flooding once it reached the cities. • Provides a guidance for designing for various habitats, cultures, type of river, geology, different levels of rainfall. • Challenges the grey infrastructure design approach • Provides a long-term legacy
3	How much work went into getting this scheme realised?	This is an on-going collaboration which started in 2020 and will continue to at least December 2024, and its outcomes will continue to be delivered after this date. It has a large global, multi-disciplinary team which are working together to realise the design and guide the client. The suite of guidance has been developed by water specialist, civils engineers, geomorphologist, landscape architects, forest engineers, urban designers, planners, ecologist and environmentalist. The guidance have been informed by the day to day support the team provides the client on their technical assurance role which includes; design reviews, workshops, reviews of deliverables, writing contract scope, reviewing tender, identifying knowledge gaps, understanding the community's needs.

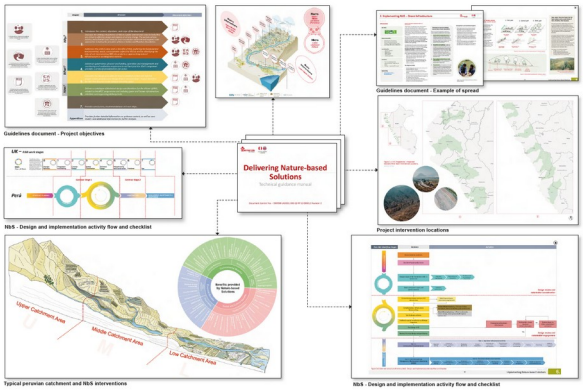
4	Is this scheme part of a masterplan or integrated into other initiatives?	The guidance is a manual for the designers to integrate into their drainage masterplans at city level, upper catchment level and river basin. The suite of guidance and the work undertaken by the team also fits outside of the city drainage design to provide a holistic design approach to catchment wide initiatives that mitigate flood and sediment impact for example; reforestation and lamination dikes. At a larger strategic scale the Peru reconstruction delivers a larger national initiative to construct 17 health facilities and 74 education centres through the use of NAI and SuDS to create climate resilient public buildings.
5	What value does this scheme provide to the local area and beyond?	The guidelines inform the local designers of the benefits of SuDS and how to integrate nature as part of the drainage and flood defence infrastructure. It encourages the design team to consider other financial, environmental and social initiatives such as, improved public realm, sense of place, healthy streets and soil conservation from the outset of the project. Managing extreme ENP weather events, provides a long-term infrastructure that protects the cities, breaking the cycle of devastation and requirement of recovery that occurs every 10 years allowing the municipality to use funding for other critical infrastructure including public health, roads and energy.

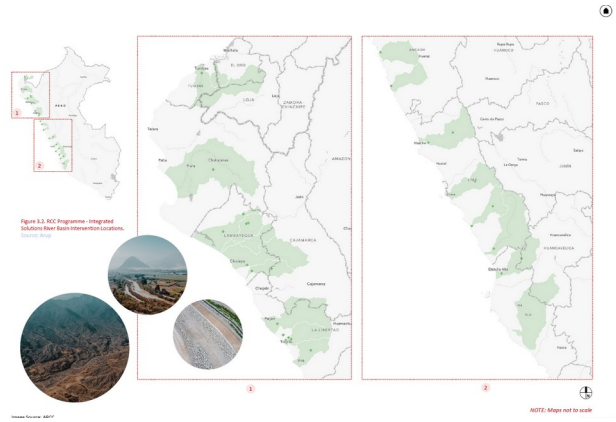
6	What challenges/problems needed to be addressed to realise this scheme?	• Ensuring client, and UKDT team understand the benefits and value of integrating SuDS into the design. • Upskilling the local designers and contractors. • Changing the cultural approach of disciplines working on their own silos. • Provides clear, useful and practical information that could be applied to various projects. • Ensuring there was suitable regional governance in place to manage and maintain the scheme. • Working in cities with lack of health care and basic infrastructure and helping them realise the social value of integrating SuDS and NAI. • Working to a tight programme, the next ENP event was expected this year.
7	How does the scheme address related issues such as water scarcity, nutrient neutrality, or biodiversity net gain?	The various schemes and supporting information have a multi-disciplinary co-design approach, by undertaking system thinking design through the catchments, river basins and cities, the design guidance focuses and advises on delivering; improved water quality, reduced sediment movement and carbon release, improved soils, habitat connections and increased biodiversity. By designing with NAI, and using the correct SuDs or NbS solution, the guidance also highlights other economic, environmental of financial benefits that should be considered as an early key performance indicator, for example; a healthy population, employment, increased local economy through food production, food security and improved living standards among many others.

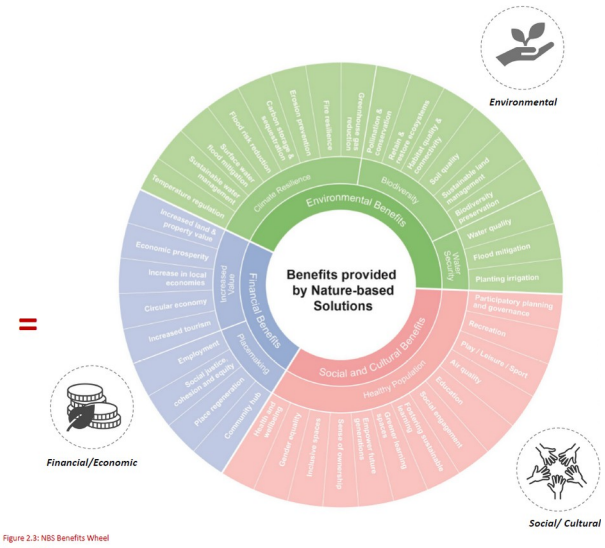
8	Is learning from the scheme continually captured and communicated? Please give examples.	The Programme runs Knowledge Transfer activities continuously through • 20% employee Learning - through social learning, coaching, mentoring, and interaction with peers. • 70% learning in day-to-day workplace (meetings, workshops, design evolution and lessons learned) in which this guidance was prepared. • 10% formal learning comprising specific topics and audiences to tackle specific issues, in which guidance where presented The guidance was produced to upskill the regional teams through a series of presentations and is used for onboarding of contractors. Its a live document, updated with lessons learnt, case studies, good and bad examples, to ensure any updates are captured.
9	What approaches/measures are taken to ensure the scheme is properly managed and maintained?	The guidance's sets out a governance approach. All projects have a contractual requirement to undertake community engagement, giving communities the opportunity to contribute the solution, facilitating a stronger connection to the interventions. The social value team have also liaised with local municipalities, charities, and communities to identify, for example, other ways of funding any SuDS intervention, leading to a feeling of ownership. The guidance highlights, • the importance of management and maintenance required at the outset of the project. • toolkit on what SuDS are, how to construct them and maintain them • Provides low maintenance design- for example; use of local trees, re-use substrate.

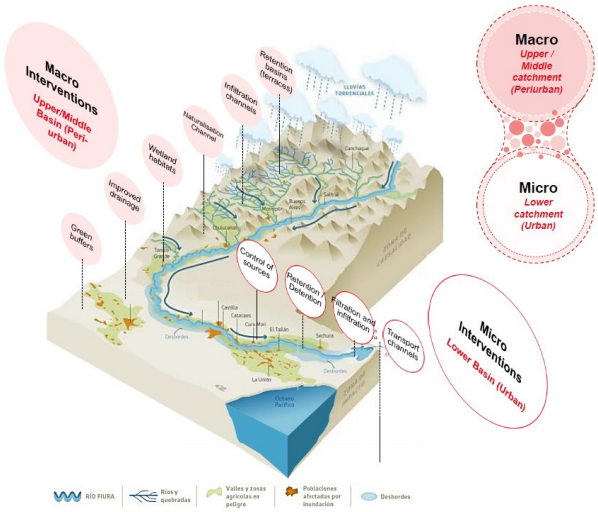
10	Have you collected any feedback on your scheme? What do people say about it? Can you provide any quotes?	All work undertaken is done in collaboration with the client as we provide technical assurance to their designs therefore, we receive continual feedback and requests to respond to challenges and requirements. Response to feedback is dependent on scenarios but we have previously presented at regional project offices or undertaken specific technical assurance forums to target critical points, or more generically gathered and implemented lessons learnt as projects have evolved.

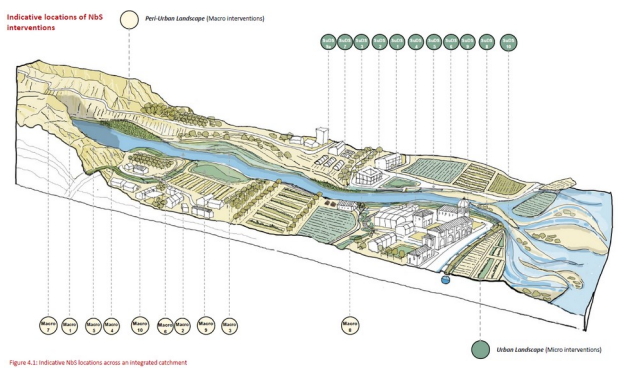
3. Supporting materials

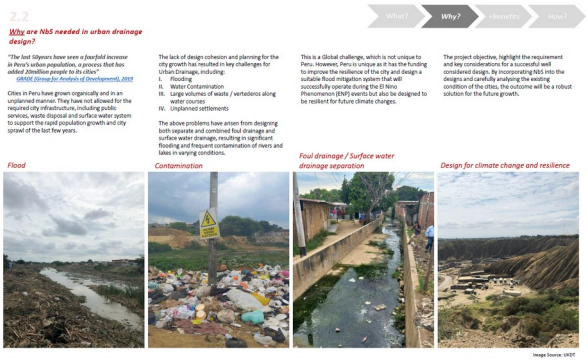
Image (low resolution)	Caption	Image credit
	*Image 1* - **Guidelines document – Examples from guidelines documents** UKDT has produced a library of guidelines for the delivery of Nature-based Solutions (NbS) in Peru. Three guidelines have been developed to reflect the different scopes of intervention of the ANIN's projects: Catchment scale, River basins, and Urban towns. These guidelines are to be read in conjunction to ensure that NbS are being considered and implemented in a strategic manner, acknowledging the wider-context and systems where they operate. By having these range of complementary resources, the UKDT expects that local designers, engineers, planners, and those with influence in policy-making, can be motivated to explore further strategies to implement Integrated NbS across infrastructural projects in the country.	Arup

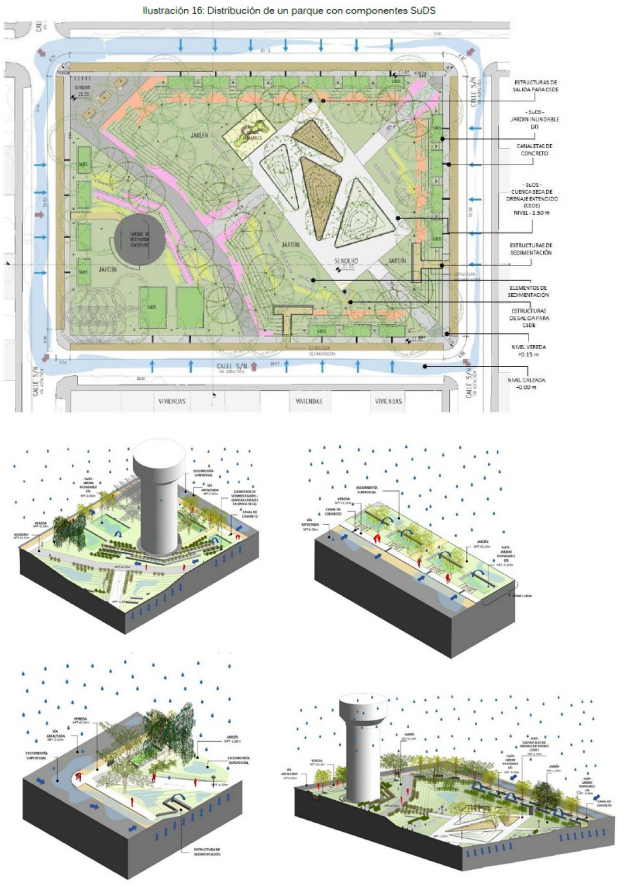
 	*Image 2* - **Peru Reconstruction Programme – Project intervention locations.** The Integrated Plan for Reconstruction with Changes (PIRCC) Programme has a core focus to address infrastructure challenges across Peru in response to the impact of El Niño and Climate Change. This directly affected 1.9 million people. The Integrated Solutions portfolio refers to the design and development of integrated flood mitigation and management solutions, applying a catchment scale approach to infrastructure delivery across 17 river basins. For each integrated river basin plan within the ANIN programme, NbS are considered as an integral component to the design and delivery of sustainable infrastructure at catchment scale.	Arup

 Figure 2.3: NBS Benefits Wheel	*Image 3* - **NbS benefits wheel** The NbS benefits diagram illustrates the environmental, social and economic improvements when using NbS in design, and as part for the city's infrastructure. The wheel has been designed to have: • The core overarching benefits in the centre • Key project objectives benefits in the second /middle tier • Co-benefits in the outer tier, these are a consequence of designing well the middle tier, although they can be targeted as individual improvements. When NbS and sustainable urban drainage systems (SuDS) are designed well, there will be an increased, cumulative effect of co-benefits. For example, improved urban drainage through implementation of SuDS will bring social and cultural benefits of a healthy population. A city with a healthy population will in turn delivery co-benefits as it will put less pressure on the health care system, increase population rates and provide healthier neighbourhoods.	Arup

	*Image 4* - **Designing urban drainage in the context of a wider integrated catchment** Introduced as a live system, any catchment shall be understood as a sum of parts. Each part can play a particular role in contributing to the alleviation of an unwanted impact, complementing other interventions by other components in the same basin. Interventions should ensure that they play a balancing role in providing an integrated solution that is simultaneously resilient and functional across the whole basin. The graphical example shows how MACRO interventions can be delivered within the upper and middle catchment, and work in synergy with MICRO interventions within the lower catchment to produce a relationship that is both sustainable and resilient. Within the upper and middle catchment, (MACRO) interventions can “Resist” and “Delay” the process of flooding on peri-urban areas before they get to more urbanised areas within the lower catchment. Within the lower catchment, (MICRO) interventions can target storage, detention, retention, reuse, filtration, and infiltration strategies within an urban context.	Arup

 Figure 4.1: Indicative NbS locations across an integrated catchment	*Image 5* - **How are NbS implemented in Urban Drainage Systems?** At the MACRO scale, within the peri-urban landscape, interventions aim to mitigate disruptions from sediment, reduce water velocity, and enhance water storage capacity. These measures contribute to the overall resilience of the area against natural challenges. Macro-scale NbS involves strategies such as comprehensive watershed management, where preserving and restoring natural vegetation in upstream areas act as a buffer against sedimentation. Green infrastructure helps in reducing water velocity, preventing erosion, and enhancing water storage capabilities. At the MICRO scale, within the urban context, interventions are geared towards mitigating disruptions caused by flood events, effectively turning urban areas into 'sponge cities.' These are urban areas that, with sufficient natural green areas and infrastructures that are designed to absorb rainfall and prevent flooding, can help tackle climate change and flood risk. NbS interventions that contribute to the 'sponginess' of a city include floodable parks, permeable pavements, and rain gardens to help absorb and slow down rainwater, and tree canopy expansion that helps mitigate flood risks but also provides shade and improves air quality. Features like green filter drains and bioswales act as natural filtration systems, enhancing the	Arup

	overall drainage system's resilience.	
	*Image 6* - **Why are NbS needed in Peruvian urban drainage design?** Cities in Peru have grown organically and in an unplanned manner. They have not allowed for the required city infrastructure, including public services, waste disposal and surface water system to support the rapid population growth and city sprawl of the last few years. The lack of design cohesion and planning for the city growth has resulted in key challenges for Urban Drainage, including: Flooding Water Contamination Large volumes of waste / vertederos along water courses Unplanned settlements The above problems have arisen from designing both separate and combined foul drainage and surface water drainage, resulting in significant flooding and frequent contamination of rivers and lakes in varying conditions. This is a Global challenge, which is not unique to Peru. However, Peru is unique as it has the funding to improve the resilience of the city and design a suitable flood mitigation system that will successfully operate during the El Nino Phenomenon (ENP) events but also be designed to be resilient for future climate changes.	Arup

	*Image 7* - **Example of floodable park, City of Chiclayo.** Among the array of projects within our program, we're currently collaborating with local designers on a floodable park located in the heart of Chiclayo, a city in northern Peru. This endeavour forms part of an innovative drainage scheme that addresses both environmental challenges and community needs. At the core of this initiative lies the concept of floodable parks, conceived as multifunctional spaces. Strategically designed, these areas serve as flood release mechanisms during intense rain events, mitigating the risk of inundation in vulnerable urban areas. Simultaneously, they play a pivotal role in enhancing the urban landscape by offering valuable public spaces in regions previously devoid of such amenities. By seamlessly integrating functionality with community benefits, these floodable parks bolster the city's resilience to climate-related risks while fostering social cohesion and enhancing the well-being of its residents.	Arup

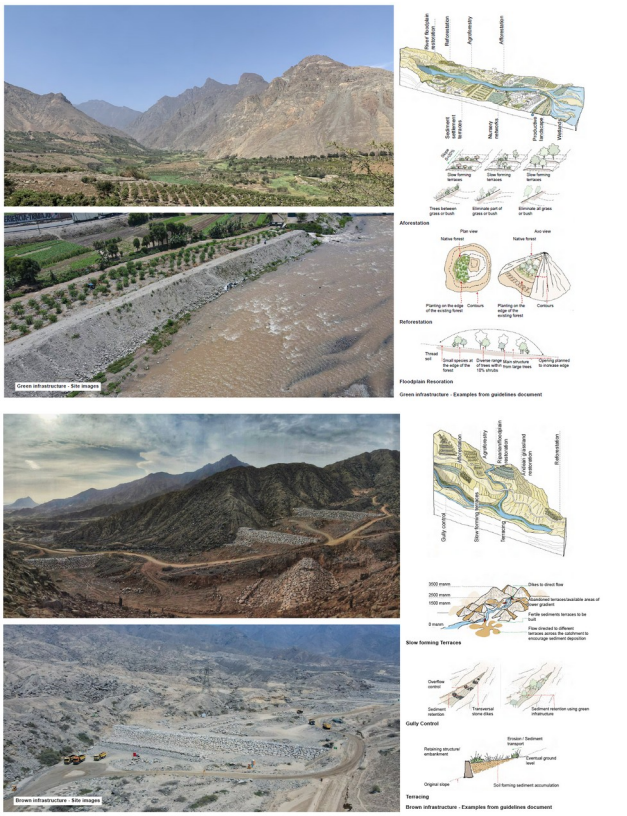


Image 8 - **Brown and Green infrastructure interventions in the upper catchment area – Site images**

To identify the appropriate interventions to mitigate climate impacts and to create the optimal design and benefits, it is necessary to consider the inclusion of green infrastructure (GI) and in some cases a hybrid solution with brown or grey infrastructure.

These interventions can range from simple components such as grassland restoration to more complexed engineered solutions (for example some terracing may require retaining walls).