Resilient Infrastructure Guidelines for Public-Private Partnership Projects in Pakistan

Federal Public Private Partnership Authority

Note: The Resilient Infrastructure Guidelines for Public-Private Partnership Projects in Pakistan (the "Guidelines"), comprising 24 pages inclusive of all Annexures, were duly approved by the Board of the Public Private Partnership Authority (the "P3A Board") at its 38th meeting convened on 5th of March, 2025. These Guidelines are hereby published under the direction of the P3A Board for general information and guidance.

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Introduction

Purpose of the guidelines

Pakistan is vulnerable to a wide range of natural hazards, particularly flooding, cyclones, drought, extreme heat waves, landslides, wildfire, and earthquakes. In the context of climate change, the intensity and frequency of weather-related shocks will increase. Pakistan is also one of the key implementers in the region of Public-Private Partnership (PPPs) projects across infrastructure sectors such as roads, airports, education and health, and water and sanitation at the federal level. It requires resilient infrastructure that can withstand the impacts of climate and disaster shocks with increased longevity of its assets benefiting the end users.

The federal Public-Private Partnership Authority (P3A) is cognizant of the need to prepare and procure resilient infrastructure for PPP projects at the federal level. It also understands the need to communicate to line agencies to consider current and future climate and disaster risks, including undertaking rapid climate and disaster risk screening at the project identification phase, undertaking detailed climate and disaster risk assessment at the design and appraisal phase, implementing disaster risk reduction at the project level, instituting risk transfer mechanisms through insurance policies and incorporating appropriate triggers of Force Majeure (FM) events at the structuring phase that incentivize both public and private parties to invest in resilient infrastructure. The guidelines also emphasize the proactive investment in adaptive measures, the standardization of climate-resilient practices, and the inclusion of community engagement throughout the process. This is designed to catalyze the flow of private capital towards more climate and disaster-resilient PPP projects.

The aim of these guidelines is to ensure that the line agencies systematically integrate considerations of disasters and climate change into PPP initiatives. These guidelines will act as a manual for embedding resilience throughout various phases of the PPP project's duration, reinforcing the idea that resilience should be a fundamental characteristic of all infrastructure procured.

Importance of resilient infrastructure

According to World Bank, every US$1 invested in resilience, realizes benefits worth US$4

As time passes, infrastructure systems become increasingly stressed due to the extreme events of climate change, natural disasters, and high demand for services. In Pakistan, this is amplifying an existing infrastructure deficit. Floods, storms, heat waves, wildfires, landslides, and other disasters impact the performance of PPPs and the services they deliver. Resilient infrastructure can sustain this pressure and adapt or transform to maintain coherent functionality in the long-term. It also protects people from climate-related hazards and helps them respond more effectively in wake of a crises and enhance their adaptive capacity. A resilient infrastructure also yields multifaceted benefits. First, it ensures the **resilience of assets**, enabling them to withstand and recover from extreme events, hence prolonging their operational life and reducing repair costs. Secondly, it enhances the **resilience of beneficiaries**, implying that those who rely on these infrastructure systems—such as communities and service users—can maintain access to critical services during and after

disruptive events. Last, it supports the **resilience of broader systems**, minimize indirect or knock-on effects such as economic disruptions, supply chain failures, and social instability. Such a layered approach ensures that resilience benefits are felt at the asset level and also ripple to create a stable and adaptive environment capable of supporting long-term sustainable growth.

In addition, resilient infrastructure reduces the financial risks as well as the costs of social damage by enhancing the resilience of communities. According to the World Bank, the net benefit of investing in resilient infrastructure in low-and middle-income countries outweighs the costs over the lifetime of new infrastructure[1]. Apart from economic benefits, social benefits from investing in resilient infrastructure include reductions in the loss of life, injuries, and displacements. It also reduces disruption of social services, including health and education facilities. Lastly, environmental benefits of resilient infrastructure include reduction in pollution and degradation of ecosystems or even the improvement of ecosystems.

Scope and applicability

The resilient infrastructure guidelines are intended to be applied to all PPP projects developed and implemented at the federal level. It incorporates guidance from climate-resilient infrastructure officer handbook by Global Center for Adaptation[2], and Principles for Resilient Infrastructure by UN Office for Disaster Risk Reduction (UNDRR)[3] that aim to mainstream resilience in all phases of infrastructure PPPs. In addition, the guidelines emphasize integration with international frameworks such as the Paris Agreement, which underscores the importance of climate-resilient development pathways, and the Sustainable Development Goals (SDGs), particularly SDG 9 (Industry, Innovation, and Infrastructure) and SDG 13 (Climate Action). By embedding these priorities, the guidelines envisage that PPP projects address local climate and disaster risks that contribute to global commitments for sustainable development and climate resilience.When defining resilience, the guidelines underscore the concepts of resilient infrastructure, which includes "*resilience of infrastructure*" and "*resilience through infrastructure*". It also highlights five major principles for resilient infrastructure systems. Lastly, it provides guidance to embed climate and disaster proofing at every phase of the PPP project lifecycle, starting from project screening (PPP suitability application), project appraisal (feasibility study/project qualification proposal), project structuring (project proposal), tendering and award (PPP agreement) and contract implementation to improve resilience for improved economic, social, and environmental outcomes.

[1] Hallegatte, S., Rentschler, J., and Rozenberg, J. 2019. Lifelines: The Resilient Infrastructure Opportunity. Washington, D.C: World Bank. © World Bank. License: CC BY 3.0 IGO. Available at: https://openknowledge.worldbank.org/handle/10986/31805

[2] Access through: https://gca.org/reports/climate-resilient-infrastructure-officer-handbook/

[3] Access through: https://www.undrr.org/publication/principles-resilient-infrastructure#:~:text=The%20Principles%20for%20Resilient%20Infrastructure,health%2C%20education%2C%20etc.%20to

Defining Resilient Infrastructure for PPPs

A. Definition of resilience

Resilience is the ability to persevere, adapt to, transform, or recover from the effects of a hazardous event in an efficient manner. A resilient PPP infrastructure will take minimum time to recover when exposed to extreme shocks and chronic stresses caused by the effects of climate change or natural disasters. Resilient PPPs will also be able to maintain stable operations by persisting through expected changes, adapting its profile to accommodate variations, and fully transforming to maintain a new function.

A resilient PPP infrastructure should encompass two aspects; 1) Resilience of the project against disasters and hazards of climate change (*resilience of infrastructure*), and 2) Resilience of community and environment, which the project is serving through that infrastructure (*resilience through infrastructure*). It is important to incorporate both these aspects into the stages of PPPs, so that the resilience remains high.

Figure 1. Key characteristics of a resilient infrastructure system

B. Resilience of infrastructure

All PPP projects must target resilience goals throughout their lifecycle, ensuring project designs effectively incorporate and mitigate climate and disaster risks. This involves identifying and quantifying such risks, exploring mitigation strategies, and addressing unmitigable residual risks through contractual risk transfer methods. The resilience of a PPP project is uniquely determined by factors such as the project's components, its susceptibility to climate and disaster risks, and financial capabilities to mitigate those risks. For any infrastructure PPP, regardless of the risk level, building resilience into both the physical and organizational aspects, including institutional arrangements of the PPP, is essential.

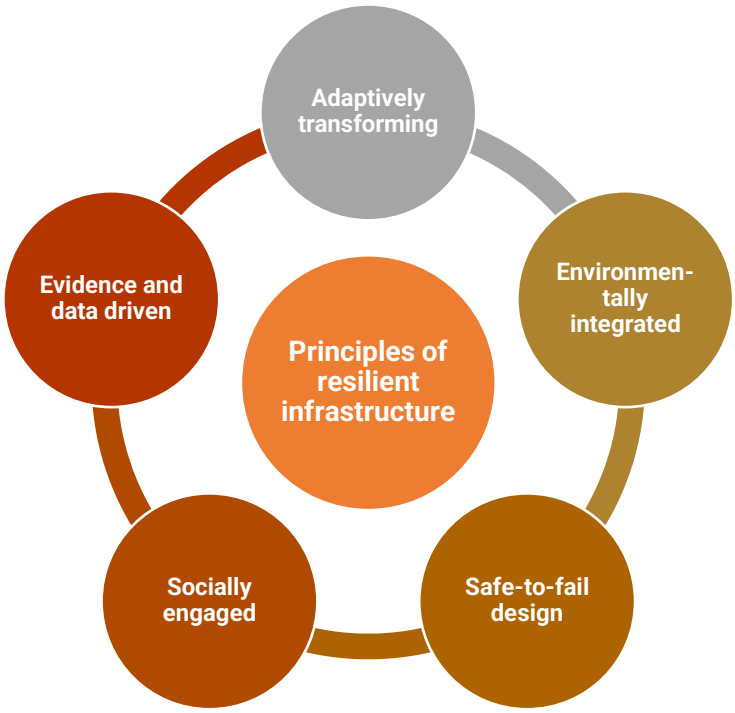
C. Resilience through infrastructure

Resilience through infrastructure is defined as an infrastructure that is put in place primarily to increase the resilience of a targeted community or asset by reducing exposure and vulnerability to a climate hazard or increasing the adaptive capacity of the community or asset. It indicates the extent to which a project enhances the resilience of the project beneficiaries. Not all projects will aim to enhance resilience through a project, but this layer helps provide an added distinction that can help line agencies prioritize projects that can provide transformational outcomes to project beneficiaries.

Principles of Resilient Infrastructure

The objective of these guidelines is to ensure that line agencies incorporate resilience throughout all phases of PPPs—from project screening to design, appraisal, structuring, tender, and implementation—and to maintain critical functions during all hazard response stages. This goal aligns with global benchmarks for climate-resilient development, notably the Sendai Framework's Target D. This target seeks to significantly lower disaster-related damage to vital infrastructure and minimize interruptions to essential services such as health and education, by enhancing their resilience by 2030. The United Nations Office for Disaster Risk Reduction (UNDRR) has outlined principles aimed at the continual enhancement of infrastructure resilience. In the context of the P3A Act 2017 (amended), these principles are reproduced for line agencies when procuring assets and services for PPPs.

Figure 2. Five key principles of resilient PPP project



A. Principle 1 - Adaptively transforming

For PPPs, building resilient infrastructure necessitates that line agencies must integrate adaptable systems to meet evolving demands of the future. This involves embedding flexibility within supply chains, delivery methods, organizational structures, and operational practices. Adaptability should be a cornerstone for line agencies procuring a PPP project throughout all project development phases, fostering a continuous cycle of modification in infrastructure, management, and information systems based on changing circumstances. To achieve infrastructure capable of adaptive transformation, a "safe-to-fail" design is crucial. This

approach ensures that even in instances of service delivery or functional failures, safety remains uncompromised. Incorporating adaptivity at the design stage allows for greater flexibility in decision-making, transitioning, and problem-solving.

Example: During the design phase of a PPP project, engineers integrate a cool roof system into the infrastructure of buildings, such as hospitals and schools, in areas prone to severe heatwaves. The roofs are made with reflective materials that minimize heat absorption and reduce indoor temperatures which maintain habitable conditions even during extreme heat. The system is designed to be scalable and allow additional cooling solutions, such as rooftop greenery, to be integrated as climate conditions evolve. Such a design flexibility ensures the infrastructure can adapt to increasing temperatures over time and can safeguard the health and productivity of the community it is built in.

B. Principle 2 - Environmentally integrated

Environmentally integrated PPPs aims to safeguard the natural environment. By utilizing natural capital constructively, line agencies must ensure to enhance project's value without compromising ecosystem integrity. PPP projects must rely on no-net harm clauses and integrate ecosystem data into decision-making to mitigate natural risks and avert ecosystem degradation. Efforts should be made to minimize environmental harm by reducing infrastructure projects' impacts on ecosystems, particularly when such activities could precipitate disasters.

Efforts should be made to minimize environmental harm by reducing infrastructure projects' impacts on ecosystems, particularly when such activities could precipitate disasters. Additionally, Nature-Based Solutions (NbS) could be integrated as part of project designs to serve as natural infrastructure buffers. For instance, restoring wetlands can act as natural flood absorbers, mangroves can provide coastal defense against storm surges, and urban green spaces can reduce urban heat islands while enhancing air quality. These NbS approaches can help mitigate environmental risks while also opening up opportunities for generating carbon credits in the future through carbon markets. For example, mangrove restoration projects can sequester significant amounts of carbon (such as Pakistan Delta Blue Carbon project), creating a dual benefit of environmental protection and potential revenue streams through the sale of carbon credits. Such financial rewards further enhance the bankability of PPP projects while aligning with global climate commitments.

While environmentally integrated approaches are critical for building resilience, it is equally essential to be aware of potential maladaptation risks. Maladaptation refers to measures that, while aimed at increasing resilience, may inadvertently create new vulnerabilities. For instance, constructing a dam to capture and control floodwater may provide significant upstream flood protection but could disrupt downstream environmental flows. Such a disruption can negatively impact the survival of aquatic ecosystems, compromise agricultural practices dependent on regular water flow, and strain the livelihoods of downstream communities who rely on those water sources for daily needs. To prevent such unintended consequences, it is important that resilience measures are assessed for their broader ecological and social impacts and not just within the project boundaries. Additionally, line agencies must take every measure to proactively manage surrounding natural environment to diminish vulnerability exposure and ensure that PPP aligns with environmental preservation.

Example: A park is in a flash-flood prone area. The PPP transaction design utilize the natural topography to create a basin that captures and slowly releases stormwater. This reduces the risk of flooding in surrounding neighborhoods and replenishes groundwater supplies. The design includes native vegetation that can thrive in wet conditions to further absorb rainwater and reduce runoff.

C. Principle 3 - Safe-to-fail Design

Given the unpredictable intensity and frequency of climate change and natural disaster hazards, resilient PPPs must account for a spectrum of risks. This necessitates that line agencies should design infrastructure systems to withstand high-risk scenarios[4], ensuring they remain robust under various conditions. Investing in risk mitigation strategies during the design phase is important, as it offers the most cost-effective means of minimizing future adverse impacts on the project. Moreover, development of comprehensive Emergency Preparedness and Response (EP&R) plans by private partners and its continued updation throughout the PPP project implementation phase, is vital for ensuring long-term infrastructure safety.

A critical consideration in the safe-to-fail approach is the equitable distribution of costs associated with risk mitigation and adaptive transformation. To achieve this, PPP contracts must include detailed resilience clauses that define responsibilities and cost-sharing frameworks between the public and private sectors (see Project Structuring section). These clauses ensure that both parties are incentivized to invest in resilience measures without disproportionately burdening one side or the other. The private sector may be incentivized to fund upfront investments in resilience (e.g., stronger materials or modular designs) by offering shared benefits such as reduced insurance premiums or performance bonuses for maintaining uninterrupted service. The public sector, on the other hand, can assume partial responsibility for resilience costs tied to broader societal benefits, such as reduced disaster recovery expenses or enhanced community safety. Resilience clauses can specify financial and operational obligations, such as the following:

- Private partners are required to maintain infrastructure resilience to defined thresholds (e.g., withstanding a 1 in 50-year flood).
- Cost-sharing agreements for retrofits or adaptive transformations triggered by changing climate projections or unforeseen risks.
- Risk pooling mechanisms for disaster costs, where contributions from both public and private sectors are allocated to a solidarity fund.

Example: In the design phase, transaction advisors incorporate advanced modeling techniques to simulate the most severe climate-related events predicted in the location. The flood barrier system includes adjustable gates capable of responding to varying water levels, reinforced seawalls to withstand powerful storm surges, and extensive drainage systems to manage heavy rainfall events. Based on the technical design, resilience clauses are embedded to specify financial and operational obligations and which party will bear what. This ensures that the infrastructure can cope with future climatic conditions, even as intensity and severity evolve and have the right incentive structure to pay for resilience.

D. Principle 4 - Socially engaged

PPP projects, being socio-technical in nature, necessitate that resilience efforts extend beyond structural robustness to also encompass societal benefits. Addressing socio-technical challenges involves enhancing social responsibility, which can be achieved through raising awareness, and incentivizing public engagement. A mechanism for ensuring that line agencies conceive PPP projects is through a sound Environment and Social Management System (ESMS) and has already been instituted through ESMS Guidelines 2023. Integrating ESMS

[4] While planning for high-risk scenarios is an essential component of resilient infrastructure design, it is important to balance these plans with realistic projections. Overestimating risks and adapting solely for extreme, unlikely scenarios can lead to maladaptation, where resources are misallocated, and infrastructure becomes overly specialized or costly. This may result in stranded assets which fail to provide its intended benefits if the anticipated conditions do not materialize. A nuanced approach is required whereby you incorporate a range of possible scenarios with a focus on flexibility and adaptability and help mitigate risk while ensuring infrastructure remains effective and sustainable.

throughout all PPP project development phase is crucial for mitigating social impacts stemming from disasters and bolstering community resilience.

Example: A line agency initiates a PPP project with a comprehensive community awareness program, educating residents about flood risks, personal preparedness, and the benefits of the new flood management system. Interactive workshops and information sessions are conducted to involve the community actively in the PPP's planning phase, ensuring their concerns and suggestions are incorporated.

E. Principle 5 - Evidence and data driven

Scientific and up-to-date data serves as the foundation for informed decision-making and effective planning. Through the analysis of historical weather patterns, future hazard projections, probability and frequency of disasters and other climate-related data, line agencies and their advisors can identify vulnerabilities and potential risks to PPP projects. Utilizing evidence-based insights allows for the design and implementation of adaptive measures that can withstand hazard impacts. A data-driven approach enhances the resilience and ensures that these vital systems can adapt to changing climate. National-level climate change and disaster models, such as the National Disaster Risk Management Fund's (NDRMF) natural catastrophe (Nat Cat) model, could be deployed for risk assessment, quantification, and allocation to establish a shared understanding of resilience goals.

Example: Line agency along with their transaction advisors gathers and analyzes extensive climate data, including historical weather patterns and future hazard projections using the Nat-Cat model for a PPP project's location. This reveals specific areas of the project most vulnerable to climatic events, subsequently guiding the prioritization of resilience measures.

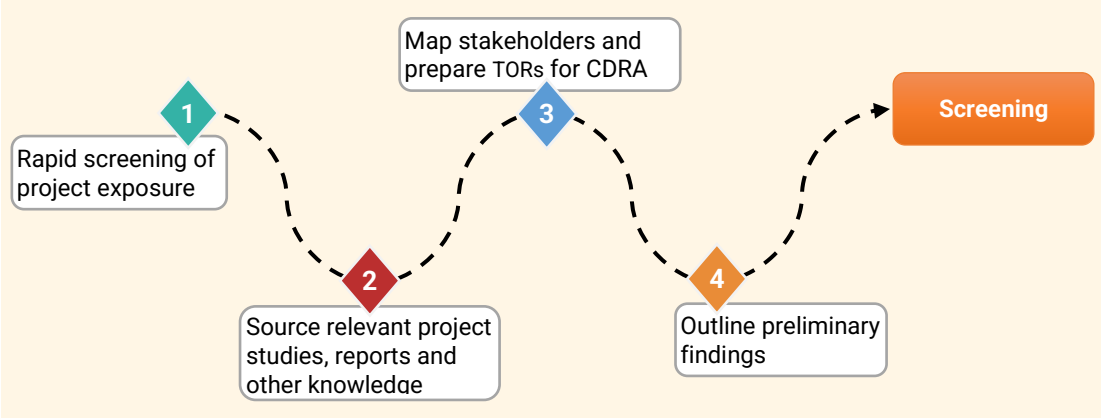
Embedding Resilience in PPP Contract Provisions

The purpose of this section is to outline possible strategies as how line agencies can integrate climate-resilient principles into the main stages of the PPP procurement process. For each of the stages, the sections will outline key ideas to integrate climate resilience and sustainable development in the PPP contract framework. This will occur through no-regret investments, followed by opting for base-layer and additional insurance provisions for risk transfers mechanisms and finally through risk retention provisions as force majeure.

A. Project identification phase

During the screening process of PPP projects, the responsible line agency will conduct a rapid climate and disaster risk screening, as outlined in Annex 1. Under this phase, a line agency will submit a PPP suitability application to P3A with an initial but a high-level climate and disaster risk profile for the proposed project. It will focus on identifying significant climate and disaster risks that could affect both the project's physical assets (resilience of the project) and the surrounding communities (resilience through the project). This approach will encompass the following four phases as illustrated below:

Figure 3. Approach for identifying resilient projects for PPP



i. Phase 1: Rapid screening of the projects and exposure to climate hazards:

This phase aims to acquire a foundational understanding of the potential hazards a PPP project might face. The line agency will evaluate project's location, along with historical climate data and past disaster events, to compile a list of pertinent hazards **Table *1***. To enhance the accuracy and reliability of hazard analysis, line agencies are encouraged to use GIS-based vulnerability mapping and other geospatial tools. Such tools allow for a detailed spatial analysis of critical and high-risk zones by integrating data on hazard intensity, frequency, and exposure.

It is important to note that while some hazards, such as earthquakes and volcanic activity, may not be directly related to climate change, they are still significant as natural disaster events and are therefore included in this assessment. While submitting PPP suitability application, a rapid screening of project must be accompanied for P3A's evaluation.

Table 1. List of common hazards by type

Geophysical hazards	Hydrometeorological hazards	Environmental hazards	Other hazards
• Earthquakes • Volcanic activity • Landslides • Erosions • Tsunamis • Liquefaction	• Storms • Rainfall and floods • Droughts • Sea-level rise • Heatwaves • Avalanches • Cold spells • Desertification	• Air pollution • Water pollution • Soil degradation • Deforestation • Loss of biodiversity • Wildfires • Salinization • Ocean acidification • Pest attacks	• Technological hazards e.g. industrial pollution, explosions • Biological hazards e.g. bacteria, viruses

The line agency will then work to fill out a rapid hazard screening matrix (**Table *2***) to identify the likely frequency[5] of a hazard occurring and the likely intensity[6] of that hazard in the project location(s). When the relevant hazards are identified, the line agency will rank their likely frequency and intensity given the high-level information review conducted. They will subsequently calculate exposure score by multiplying the hazard's frequency score by its intensity. Any hazard with an exposure score of 3 or higher should be further investigated at the Climate and Disaster Risk Assessment (CDRA) stage.

Table 2. Rapid hazard screening matrix

Hazards	Likelihood of frequency in location	Level of intensity on project	Hazard score = Frequency x intensity	Further CDRA evaluation warranted
Flood	3	4	12	Yes
Wildfires	3	2	6	Yes
Riverine flooding	2	1	2	No
Landslide	1	2	2	No

Score: 0-none, 1-low, 2-medium, 3-high, 4-very high

ii. Phase 2: Sourcing relevant studies and reports

Post the initial rapid hazard screening, it is important that line agencies engage in a more in-depth investigation by acquiring pertinent project studies, reports, and other relevant data that captures past climate/disaster impacts on the proposed project location. This stage plays an important role in pinpointing the necessary information required for conducting a comprehensive CDRA. The focus here is on collecting key baseline data, which includes studies related to similar projects or those that have encountered similar hazards in the past.

iii. Phase 3: Stakeholder Mapping and TOR Preparation

This phase includes stakeholder mapping and finalization of Terms of Reference (TOR) for the climate and disaster risk assessment (CDRA) that a line agency must carry out in coordination with its transaction advisors for detailed climate and disaster risk assessment.

[5] Frequency - the likelihood of a hazard's impact occurring in the project area
[6] Intensity - the level of disruption of the hazard's impact in the project area

This stage entails identification and involvement of stakeholders, such as climate experts, governmental bodies, infrastructure specialists, local non-governmental organizations (NGOs), academic institutions, and research organizations that must be contacted to finalize CDRA. For all PPP projects with infrastructure elements, it will be mandatory for line agencies to conduct a climate and disaster risk assessment as part of their comprehensive feasibility assessments. Sample TORs for this exercise are outlined in Annex 2.

iv. Phase IV: Outlining Preliminary Findings

Upon completion of the screening process, line agencies will wrap up by presenting initial conclusions concentrated on the integration of resilience factors into the proposed PPP project. This will lay out how the proposed project intends to enhance resilience through absorptive, adaptive and restorative capacities. To ensure comprehensive resilience planning, social engagement can be prioritized by integrating local knowledge systems and promoting community-led monitoring. Local communities possess valuable insights into historical hazard patterns and effective mitigation strategies, which should inform the design and operation of PPP projects. Additionally, community involvement in monitoring disaster readiness and project performance can foster ownership and can ensure that the infrastructure aligns with local needs. The guidelines also emphasize the importance of embedding gender-sensitive design in resilience planning to address the specific needs of women, children, and other vulnerable groups. The development of resilience may also occur directly through the construction of infrastructure or indirectly through community-based programs. The line agencies will summarize their findings as outlined in the Table 3 below and will make this as part of its PPP suitability application to P3A. Overall, these preliminary findings will help assess the physical resilience of the PPP project and will align with key aspects of project bankability and risk to service delivery. While integrating resilience factors such as absorptive, adaptive, and recovery capacities, it is envisaged that this will positively influence the project's attractiveness to investors and lenders.

Table 3. Template for preliminary findings

Characteristic of resilient infrastructure	Yes/No	Details
Absorptive capacity Does the PPP project has the ability to absorb the impacts of climate change and natural disasters and minimize the consequences?		
Adaptive capacity Does the PPP project has the ability to adjust to climate impacts by undergoing changes?		
Recovery and restorative capacity Does the PPP project has the ability to transform or return to normal after the impacts, without compromising functionality?		

B. Project appraisal phase

In the context of PPPs, the project appraisal phase is a critical step where the line agency evaluates the potential projects in detail and work on their feasibility or Project Qualification Proposal (PQP) submission to P3A. This phase involves an analysis of the project's feasibility, including its economic, technical, financial, and environmental aspects. A key focus during this phase will be an assessment of project's resilience to climate and disaster risks, ensuring that the PPP transaction is viable and adaptable to future challenges. This will be undertaken

through a comprehensive Climate and Disaster Risk Assessment (CDRA) and will be part of the transaction advisor TORs (Annex-2). When evaluating PQPs from line agencies, P3A will assess disaster and climate risks through its evaluation of both CDRA and ESMS.

CDRA will become a crucial component to design resilient infrastructure PPPs. Risk assessments for infrastructure will refer to a process of identifying how key infrastructure (facilities and networks) will resist, absorb, accommodate, adapt to, transform and recover from the effects of different shocks and stresses. Line agencies will clearly incorporate TORs for transaction advisors for preparation of a comprehensive CDRA besides financial, legal and technical feasibilities. The aims of CDRA will be to:

- Incorporate disaster and climate risks under consolidated risk register
- Identify key hazards, exposure to hazards, and vulnerabilities of the proposed PPP project
- Understand the potential impact on the natural and built environment, people and communities.

C. Project structuring phase

After appraising natural hazards, it will be essential to proceed to the project structuring phase to incorporate resilience into PPP agreements for the purpose of risk distribution. This phase involves the integration of CDRA findings into the project's contractual and operational frameworks with an objective that the PPP project meets functional requirements and is adaptable against future environmental uncertainties and a clear risk allocation framework.

The PPP contract during this stage must incorporate specific findings derived from the CDRA and Environment Assessments. This includes clauses for environmental compliance, risk-sharing mechanisms for climate-related events, and any additional requirements for sustainable materials and construction practices. The contractual elements within a PPP contract structure will guarantee that both public and private parties are committed to and responsible for the resilience of the PPP project.

During the project structuring phase, a three-step framework will be followed, starting from i) incorporating no-regret investments and beyond, ii) risk transfer mechanisms through insurance, and iii) risk retention through coherent Force Majeure (FM) clauses.

i. No-regret investments and beyond:

In the PPP structuring phase, all line agencies will prioritize no-regret investments and beyond as recommended by the transaction advisors. No-regret and other adaptive investments are characterized by their ability to offer advantages in both present and future conditions, reducing risks and enhancing infrastructure efficiency without imposing significant additional costs. Line agencies must treat no-regret measures as important elements in their PPP projects, which will be informed through CDRA and presented by transaction advisors. These could include, for example, additional construction standards, adaptable infrastructure elements, and efficient resource use practices (**Table *4***). A list of no-regret investment measures will be proposed by transaction advisors and will be finalized by the line agency after consultations with P3A and qualified technical experts.

While prioritizing no-regret investments is a foundational step, the comprehensive CDRA conducted should inform a broader range of strategic actions. These include dynamic and phased adaptation pathways including disaster risk reduction initiatives, flexible and modular infrastructure design and adaptive management plans. They are outlined as follows:

a. **Dynamic Adaptation Pathways:** Line agencies must consider adopting a pathways approach to adaptation, which will involve identifying key decision points and planning incremental measures that can be activated as specific climate thresholds or triggers are met. Such a strategy will reduce the risk of over-

committing resources prematurely to adaptation that may not align with actual climate developments.

Example: For a riverbank infrastructure PPP project along a river, a phased adaptation plan could include initial investments in embankments and levees that can be strengthened or extended if future projections of monsoon intensity and river flow volume increase beyond current expectations. This approach would ensure that investments align with the evolving realities of climate change, such as increased rainfall variability and glacial melt, which will optimize the cost-effectiveness and long-term sustainability of the infrastructure.

b. **Flexible and Modular Infrastructure Design:** With utilizing insights from the CDRA, line agencies must integrate modular and scalable infrastructure elements. These designs will allow for infrastructure components to be upgraded or modified as conditions change which can avoid the pitfall of stranded assets.

Example: A transport corridor can be constructed with reinforced embankments that are designed to be heightened or fortified over time as flood risk assessments evolve and will ensure continuous protection and operational resilience.

c. **Adaptive Management Plans:** Embed adaptive management principles within the PPP contracts which will allow both public and private partners to reassess and update resilience measures periodically based on observed climate impacts and emerging data. This contractual flexibility ensures that the project remains effective and viable over its lifespan.

Example: For a flood mitigation PPP project, adaptive management plan could involve integrating real-time hydrological monitoring and forecasting systems into the infrastructure's operation. Such a system would allow the infrastructure to respond dynamically to changes in river flow and rainfall patterns. The PPP contract would include clauses allowing for periodic reviews every three to five years during which the data from these monitoring systems would be analyzed to inform adjustments to flood control measures.

Table 4. Illustration of no-regret investments

No-Regret Investment	Benefits	Applicable Project Types
Intelligent transportation systems (ITS)	Improves traffic management, enhances safety, reduces congestion	Roads, Bridges, Motorways
Eco-friendly pavements	Reduces urban heat island effect, improves stormwater management	Roads, Motorways
LED lighting	Reduces energy consumption, lowers maintenance costs	Roads, Bridges, Urban Transport
Seismic retrofitting	Enhances resilience against earthquakes	Bridges, Social Sector Infrastructure
Stormwater management systems	Mitigates flood risks, enhances water quality	Roads, Urban Transport, Water Projects
Pedestrian pathways	Promotes sustainable transport, improves public health	Urban Transport
Water treatment technologies	Enhances water quality, ensures sustainable water supply	Water Projects

Smart metering for water	Reduces water losses, encourages efficient use	Water Projects
Green infrastructure	Reduces runoff, improves air quality, enhances urban aesthetics	Urban Transport, Water Projects

ii. Risk transfer using insurance in PPP contracts

Incorporating no-regret investments into a PPP project sets a standard for resilience. To shield the public sector from potential cost increases due to natural hazards and climate-related shocks, it is important for the line agency to secure insurance policies as a risk transfer mechanism. Central to this strategy is the formulation of method for embedding insurance within the PPP contract framework. This establishes insurance as a key instrument to protect against financial risks associated with climate and disaster events and ensuring protection for both the public and private parties to support project's continued practicality. Different types of insurances and its roles are identified in (**Table 5**) below.

Table 5. Role of different types of insurance in infrastructure resilience

Type of Insurance	Role in Infrastructure Resilience
Property Insurance	Covers damage to infrastructure from natural disasters, ensuring financial resources for repair and rebuilding, maintaining the physical resilience of the project.
Liability Insurance	Protects against claims for injuries or damages, ensuring the project can continue without financial liabilities from third-party claims.
Business Interruption Insurance	Compensates for lost income during post-disaster recovery, supporting financial stability and continuity of the project operations.
Construction All Risk Insurance (CAR)	Covers risks during the construction phase, including accidental damage, ensuring that construction can proceed smoothly despite unforeseen incidents.
Political Risk Insurance	Provides protection against risks like expropriation or civil unrest, ensuring project stability in politically volatile environments.
Environmental Insurance	Covers costs related to environmental damage, ensuring resources are available for necessary clean-up and compliance with environmental standards.
Climate Risk Insurance	Focuses on risks associated with climate change, such as extreme weather events, providing targeted financial protection and supporting long-term project adaptability.

When structuring a PPPs for resilient infrastructure, it's important to balance the need for comprehensive risk coverage with the cost implications of insurance. Not all insurance coverages may be necessary from the outset, as obtaining them all simultaneously can significantly increase project costs. The key is to align insurance requirements with the specific risks identified under CDRA. If a risk is elevated under CDRA (e.g., floods), it is recommended to mitigate it through an insurance provision (flood insurance protection).

For these guidelines, insurance categories can be broken down under two levels, base level insurances and risk-specific insurances.

- Base-Level Insurance: Initially, essential insurances, such as property insurance, Construction all Risk (CAR) and liability insurance, will be prioritized for all PPP projects. These provide fundamental coverage against common risks and are generally crucial for all PPP infrastructure projects.

- Risk-Specific Insurance: Based on the CDRA findings and informed analysis by transaction advisors, additional insurances can be incorporated to address project specific vulnerabilities. For example, if a project is in an earthquake-prone area, integrating earthquake insurance becomes important.

If the CDRA indicates heightened vulnerability, the following additional insurances may be purchased:

- Flood or earthquake insurance: For projects in areas susceptible to these natural disasters, specific insurance to cover damages from such events would be essential.
- Environmental insurance: In PPP projects where environmental damage or pollution risks are high, this insurance will cover cleanup and liability costs.
- Climate risk insurance: For PPP projects significantly exposed to climate change effects, like extreme weather conditions, this specialized insurance provides targeted protection.
- Business interruption insurance: If the CDRA suggests a high risk of operational disruptions, this insurance covers the loss of income during such periods, ensuring financial stability.

The goal is not to escalate the costs of a PPP project by procuring numerous insurance policies. The objective is rather to carefully select an appropriate suite of insurance coverages through an informed CDRA that guarantees the project's resilience and disaster-proofing over the long haul. This will enhance project's durability to withstand adverse events and protect public party from unforeseen fiscal impacts.

iii. Risk retention for climate and natural disaster events

It is important to utilize the findings from the CDRA and DRR measures to identify and quantify residual risk - the level of risk remaining after all feasible mitigation strategies have been implemented. This residual risk is essential for an informed decision-making regarding whether the risk should be retained by the public sector or transferred to the private sector.

Traditionally, climate shocks have been classified as force majeure (FM) events in PPPs, viewed as beyond the control of all parties and typically borne by the public sector. However, with the evolving need for climate-resilient infrastructure, this perspective is shifting. Planning for climate shocks and stresses is imperative, and it is not tenable to broadly categorize all climate shocks as FM events. Currently, the definition is not based on the results of project-specific disaster and climate risk assessment and any flooding event irrespective of magnitude that materially affects the project is considered a FM event. An open-ended definition has the potential to shift all (major and minor) disaster costs to the public party, burdening its fiscal balances.

To refine this approach, the line agency must clearly articulate what will constitute an unforeseen climate risk event based on hydrometeorological and geophysical risk assessments during the appraisal stage. This determination is crucial in the contract structuring phase. For instance, through CDRA analysis, if climate projections suggest that floods will intensify and become more frequent, this knowledge must inform the structuring process. Not all events should automatically be treated as FM. Instead, only truly exceptional climate events, such as a 1 in 100-year flood event[7], must be categorized as a FM event. To avoid any ambiguity, this distinction will be explicitly stated in the contract by the line agency in coordination with the transaction advisors and P3A.

[7] The definition of truly exceptional climate events, such as a 1 in 100-year flood event will be determined on a project-by-project basis. This will be informed by detailed analyses conducted by transaction advisors, who will incorporate findings from hydrometeorological data, climate projections, and geophysical risk assessments and will tailor definitions to ensure that the categorization of force majeure (FM) events align with specific project contexts which is grounded in evidence-based risk evaluation.

On the other hand, temporary FM events, such as flash flooding will be categorized differently. These may be considered relief or compensation events and transferred to the private sector through insurance or private partner's own improved O&M practices. This approach ensures a more responsible handling of climate-related risks, aligning PPP contracts with on-ground disaster realities to potentially limit fiscal costs to the public exchequer.

D. Tender and award phase

The tender stage offers opportunities for the line agency to embed, evaluate and develop climate resilience considerations into the PPP Agreement. This process will encompass designing the contract, qualifying bidders, tendering the project, and evaluating bids received. As much of the project-related analysis will have been completed, the line agency will now have a good understanding of the climate and disaster risks involved due to CDRA and risks allocation under project structuring.

During the tender and award phase, the line agencies will have following considerations:

- Communicate and set construction and operation standards (including ESMS)
- Incorporating KPIs, including regular monitoring

i. Communicate and set construction and operation standards (including ESMS)

During tender phase, line agencies will have an opportunity to define explicit construction standards in the contract. Pakistan already possesses a range of engineering, construction, and built environment standards, codes, and regulations that are geared towards mitigating climate and disaster risks. However, a notable challenge is that these standards frequently rely on historical data, which may not adequately anticipate future climate conditions.

Box 1. Notable standards and codes relevant to infrastructure in Pakistan

- Building Code of Pakistan – 2021
- P3A-Environmental and Social Management System - 2023
- Building Code of Pakistan- Fire Safety Provisions – 2016
- Building Code of Pakistan- Energy Provisions – 2011
- Building Code of Pakistan – Seismic Provisions – 2007
- Pakistan Electric – Telecommunication Safety Code (PETSAC) – 2014
- Construction & Operation Engineering Works Byelaws 1987

There's a growing trend to incorporate climate resilience into design codes, financial reporting, and due diligence processes. A significant issue is the tendency for many of these codes to be outdated in terms of current climate and disaster projections. To avoid this, line agencies, in coordination with transaction advisors, must incorporate emerging standards into the procurement procedures and contractual commitments. Where required, they should also propose supplementary guidelines for design, construction, operations, and maintenance to guarantee that the project adheres to advanced resilience standards. This integration process necessitates to assist in pinpointing project-specific requirements.

Furthermore, line agencies will also mandate that private partners adhere to specific, pre-established standards for resilient infrastructure under the PPP Agreement. Where prudent, this could be made compulsory in the bidding process, where it becomes mandatory to include adherence to pre-defined resilience standards. Proposals that fail to meet predefined resilience criteria could be considered non-compliant.

ii. Incorporating KPIs

In this phase, the line agency must integrate disaster-related Key Performance Indicator (KPI) criteria into the PPP Agreement. This entails defining specific KPIs that surpass standard

performance requirements for inclusion in the PPP Agreement, which the Independent Engineer (IE) will monitor throughout the project's operations and maintenance phases. A comprehensive evaluation plan and corresponding reporting mechanisms will be elaborated to maintain the service quality or the resilience of the PPP asset, with the IE's verification.

To enhance the effectiveness of monitoring, the guidelines recommend establishing adaptive management protocols that incorporate periodic reviews of resilience measures based on evolving risks. These adaptive feedback loops will enable the incorporation of new data, updated climate projections, and lessons learned from operational experiences into project management. For instance, if new flood risk assessments reveal higher-than-anticipated vulnerabilities, the periodic review could prompt adjustments to infrastructure defenses or operational protocols. Such triggers will ensure that the PPP asset remains adaptable throughout its lifecycle.

The contract should incorporate the following recommended actions to be monitored by IE on a continuous basis as detailed in **Table *6*** below as well as the following reporting considerations:

- A defined approach for the IE to continuously report on climate and disaster risks.
- Ongoing assessment procedures to evaluate the resilience impact of the infrastructure and its additional benefits.
- A reporting structure specified in the contract detailing the schedule for the IE's reports submission for the evaluation by the line agencies.

Table 6. Plan for monitoring, evaluation and reporting

KPI Category	Monitoring KPIs
Infrastructure durability	- Frequency and nature of infrastructure repairs necessitated by climate events - Durability of infrastructure components when subjected to extreme weather conditions - Changes in structural integrity over time with exposure to various natural hazards
Emergency response effectiveness	- Time taken to respond to disaster events - Efficacy of emergency protocols and response systems in place - Coordination with local emergency services and efficiency of communication channels
Environmental impact	- Changes in carbon footprint over time - Success of pollution control measures implemented - Effects on local biodiversity and natural ecosystems
Community resilience	- Levels of community awareness and disaster preparedness - Accessibility and functionality of infrastructure during and after disasters - Influence on local economies and livelihoods in the face of disaster events
Operational continuity	- Duration and frequency of service disruptions or downtime - Speed and effectiveness of service restoration after a disaster - Adaptability of operational procedures to maintain continuity under disaster conditions
Preventing maladaptation	- Extent to which the resilient infrastructure fulfills the purpose it was designed for (e.g., flood defense systems during heavy rainfall), frequency of its utilization, and whether it functioned as planned to mitigate risks. - Effectiveness of infrastructure in reducing long-term risk exposure to climate hazards without creating new vulnerabilities e.g., floodwalls diverting water and increasing flood risk elsewhere)

E. Implementation

The implementation phase of a PPP project will focus on monitoring of KPIs around disaster and climate resilience. Monitoring during the construction phase will ensure that progress aligns with the established schedule and adheres to technical specifications, effectively taking the project towards disaster resilience from the outset. As the project transitions into the operational phase, performance monitoring becomes crucial to confirm that the infrastructure asset delivers the services at the agreed-upon standards, including meeting or exceeding thresholds set for climate and disaster resilience. This includes ensuring that the asset can withstand and function in the face of climate-related challenges. In the maintenance phase, the emphasis of monitoring shifts to the adherence to maintenance specifications outlined in the PPP Agreement, ensuring that the asset remains in optimal condition, with agreed upon resilience parameters.

The IE will verify the KPIs to ensure that the PPP meets service standards and targets in accordance with criteria for resilient infrastructure. Stakeholder engagement, as part of the broader ESMS guidelines, will continue to be an important element. This will include engaging in conversations with local communities, conducting consultations to gauge user satisfaction with the PPP asset, and exploring the wider impacts and advantages the public gains from the PPP project, beyond the immediate services provided.

Annexures

Annex 1: Rapid Climate and Disaster Risk Screening Template for PPP Projects

To be completed in conjunction with the environment and climate risk screening templates provided under the ESMS guidelines.

Please fill the following rapid screening template for PPP projects with the following scores
Score: 0-none, 1-low, 2-medium, 3-high, 4-very high

Frequency in the context of climate risk screening refers to how often a climate-related hazard, such as a flood or drought, is likely to occur within a specified time frame.

Intensity refers to the strength or severity of the climate-related hazard when it does occur. This can include factors like the depth of floodwaters or the duration of a heatwave.

Exposure is the measure that represents the extent to which an infrastructure project is subject to potential damage by considering both how often a hazard occurs (frequency) and how severe the hazard is (intensity). It quantifies the level of risk the project faces from climate-related events.

Score	Frequency	Intensity
Score of 0 (none)	The event is not expected to happen.	No impact is anticipated.
Score of 1 (one)	The event might happen occasionally.	Impacts are minor and easily manageable.
Score of 2 (two)	The event happens regularly.	Moderate impacts that may require some effort to manage.
Score of 3 (three)	The event happens often.	Significant impacts that will need considerable resources to manage.
Score of 4 (four)	The event is almost certain to happen repeatedly.	Extreme impacts with potential for severe consequences.

Calculate Exposure: Multiply the frequency score by the intensity score to get the exposure score for each hazard. For example, if a flood has a frequency score of 3 (high) and an intensity score of 2 (medium), the exposure score would be 3 * 2 = 6.

Determine the Need for Further Analysis: If any hazard has an exposure score of 6 or above, it indicates a significant risk to the project and warrants a deeper analysis under the Climate and Disaster Risk Assessment (CDRA).

Template for Risk Screening

Hazards	Likelihood of frequency in location (A)	Level of intensity on project (B)	Exposure score = Frequency x intensity (A*B)	Further CDRA evaluation warranted
Geo-physical hazards				
Earthquakes				
Volcanic activity				
Erosions				

Tsunamis				
Liquefaction				
Landslides				
Hydro-metrological Hazards				
Storms				
Rainfall and floods				
Droughts				
Sea-level rise				
Heatwaves				
Heatwaves				
Avalanches				
Cold spells				
Environmental Hazards				
Air pollution				
Water pollution				
Soil degradation				
Deforestation				
Loss of biodiversity				
Wildfires				
Salinization				
Ocean acidification				
Air pollution				
Technological hazards				
Biological hazards				

Annex 2: Sample Terms of Reference for Climate and Disaster Risk Assessment (CDRA)

Introduction: This document outlines recommended Terms of Reference (TOR) for line agencies to use when hiring services for conducting a Climate and Disaster Risk Assessment (CDRA). The CDRA is a critical component of the feasibility study, providing an assessment of climate and disaster risks associated with PPP at the federal level.

Objective: The primary objective of the CDRA is to identify, validate, analyze, and propose mitigation strategies for climate and disaster risks that could impact the infrastructure project during its lifecycle.

Scope of Work

1. **Risk Identification and Analysis**
   - Conduct a detailed assessment of potential climate and disaster risks relevant to the project's location and scope.
   - Identify risks related to extreme weather events, long-term climate changes, and potential natural disasters.
   - Evaluate the likelihood and potential impact of these risks on the project.

2. **Vulnerability Assessment**
   - Analyze the vulnerability of the proposed infrastructure to identified risks.
   - Consider factors such as geographic location, design specifications, and materials used in construction.

3. **Mitigation and Adaptation Strategies**
   - Develop strategies to mitigate identified risks.
   - Propose adaptive measures to enhance the resilience of the infrastructure.
   - Include recommendations for design modifications, material choices, and construction techniques.

4. **Stakeholder Engagement**
   - Engage with local communities, environmental experts, and government bodies to gather input and insights.
   - Facilitate workshops or consultations as part of the risk assessment process.

5. **List of "No-Regret Measures"**
   - The final report should present a detailed list of "no-regret measures" that are essential for the project's resilience. These measures should be practical, cost-effective, and applicable regardless of future climate scenarios.
   - The list should provide clear guidance on how these measures can be integrated into the project contract, ensuring that they are non-negotiable elements of the project's design and implementation.

6. **Extra and Specific Insurance Requirements**
   - The CDRA should identify additional and specific insurance coverages that the private party must procure. This recommendation should be based on the unique risks and vulnerabilities identified in the assessment.
   - The report should provide detailed rationale for each recommended insurance type, considering the project's specific climate and disaster risk profile.

7. **Disaster Categories for Force Majeure Events**
   - The report must clearly define which disaster categories should be considered as force majeure events in the context of the project. This should align with the identified risks and their potential impacts on the project.
   - Criteria for categorizing an event as force majeure should be explicit, considering both the likelihood and severity of potential climate and disaster events.

8. **Regulatory Compliance**

- Ensure that the CDRA aligns with national and international standards and regulations related to climate and disaster risk.

9. Reporting

- Prepare a comprehensive report detailing the findings of the CDRA.
- Include an executive summary, detailed analysis, and practical recommendations.
- Provide clear and actionable steps for integrating the CDRA findings into the project design and implementation.

10. Integration of Deliverables into Project Contract

- The findings and recommendations provided in the CDRA report, especially the no-regret measures, specific insurance requirements, and force majeure event categories, must be directly integrated into the PPP project contract.
- The line agency should use these deliverables as a basis for drafting contract clauses related to risk management, insurance, and force majeure provisions.

11. Deliverables

- A comprehensive CDRA report including risk analysis, vulnerability assessment, mitigation strategies, and adaptation measures.
- A set of practical recommendations for project design and implementation.
- Documentation of stakeholder engagement and consultations.
- List of no-regret, insurance, and force majeure clauses

Qualifications and Expertise Required

- Proven experience in conducting climate and disaster risk assessments for large-scale infrastructure projects.
- Expertise in environmental science, engineering, risk management, or related fields.
- Familiarity with local, national, and international environmental regulations and standards.
- Strong analytical and reporting skills.
- Specialists conducting the CDRA must possess expertise in risk management, insurance, and legal aspects related to force majeure in infrastructure projects.
- The team should include professionals who can translate technical risk assessments into practical contract provisions.

Duration and Timeline

- The CDRA should be completed within [specify duration] months from the commencement of the contract.
- A detailed timeline for the assessment, including milestones and deliverables, should be provided.