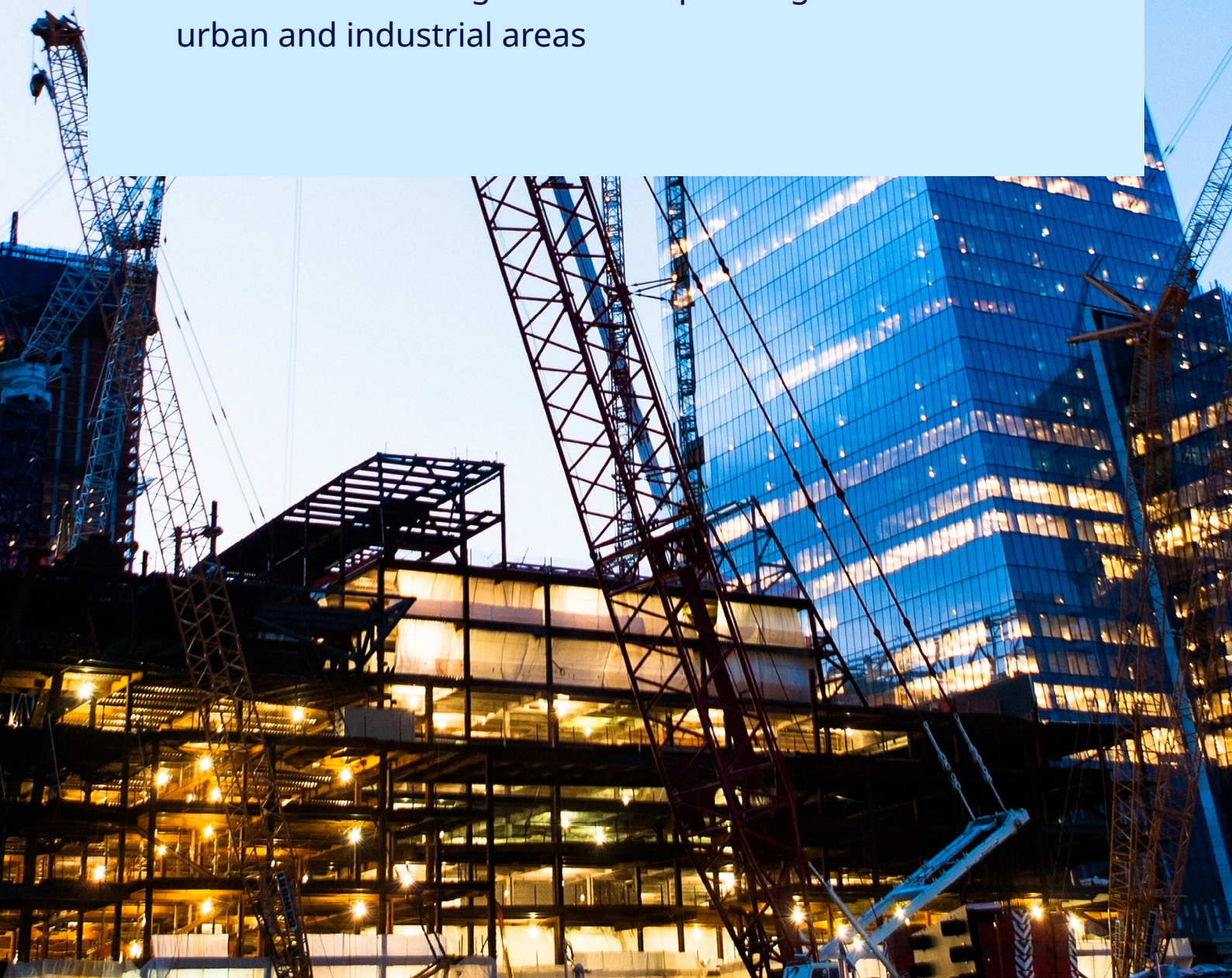
MARSH

# Addressing the system-level resilience gap

A framework for organizations operating in urban and industrial areas



# Contents


1. Urban and industrial areas: The front line of system-level risk 3

2. What are system-level risks? 5

3. An approach for organizations to address system-level risk 8

4. What does addressing the system-level resilience gap look like in practice? Four lessons from around the world. 10

5. Conclusion: System-level risk management as a core capability for urban and industrial investment 15

6. Acknowledgements 17

7. References 17

8. Appendix: Adaptation checklists 19

# 1

# Urban and industrial areas: The frontline of system-level risk

Urban and industrial areas are where people, assets, and critical infrastructure concentrate, and where climate-related disruptions manifest most acutely: a heatwave, flood, drought, or wildfire rarely remains a "local" physical hazard once it hits an urban environment. Instead, these hazards propagate through shared systems such as energy, water, transport, telecommunications, and healthcare, turning a hazard into wider operational disruption, not just locally, but across entire value chains. Organizations, therefore, need resilient cities to function well in order to protect them from events such as workforce disruptions, supply interruptions, reputational impacts, and knock-on effects on customers.

There are several initiatives that have championed city-level resilience, such as the Rockefeller Foundation's 100 Resilient Cities and the C40 Cities program, highlighting the growing importance of urban and industrial environments. From a business perspective, however, we find that practical guidance beyond public-private collaboration is often lacking, leaving organizations with significant exposure when assessing where to invest, how to expand in existing locations, or how to build resilience across their urban and industrial footprints.

This paper aims to help organizations address that gap. It focuses on system-level risks — risks that arise from the fragility of, and interactions between systems — rather than on physical damage to individual sites alone. Not all system-level risks operate at the same scale: some are place-based — contingent on the resilience of the local environment on which an asset depends to operate — while others influence an organization irrespective of where any individual asset sits. It offers a practical set of checklists for organizations to apply when investing in new urban and industrial areas or upgrading risk management approaches in existing locations. Finally, we touch on key lessons learnt from integrating this framework in real-world examples.

# 2

# What are system-level risks?

The Marsh Risk Climate Adaptation Framework is an enabler for this conversation: it differentiates between risks at individual assets owned by an organization and risks associated with dependencies in an organization's external ecosystem. Asset-level risks can typically be controlled directly, such as risks to the physical asset, risks to operations and people working on site, and risks to the successful execution of emergency response procedures. Conversely, system-level risks include threats to elements organizations depend on but may not fully control, such as suppliers, customers, critical infrastructure, resources and ecosystem services, governments and regulators, capital providers, and communities (Figure 1).

**Figure 1. The Marsh Risk Climate Adaptation Framework: organizations should consider both asset- and system-level considerations**

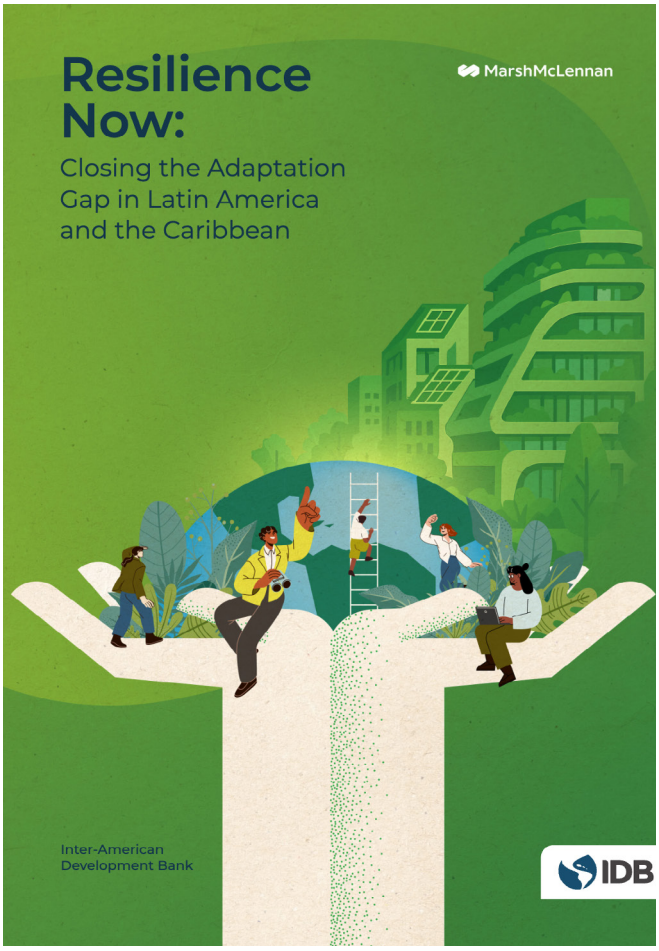
System-level risks can arise when assets depend on the rest of the system. For example, a business owner with assets in an industrial area may depend on nearby housing, hospitals, and other systems to ensure resilient operations. These dependencies create place-based risk whose severity is shaped by the climate resilience of that specific location. The same business may also face climate-driven disruptions to international supply chains; this exposure is no less systemic, but agnostic to the geography of any individual asset. There is a risk of system-level risks occurring simultaneously, often driven by multiple climate impacts (e.g., heat stress and water scarcity). Equally, system-level risks can be cascading; for example, a flood event that results in transport disruption may, in turn, prevent workforce mobility and delay emergency response.

Many large organizations have made significant progress in understanding climate risk at the asset-level, but system-level risk is often overlooked. In 2025, we found that most organizations' climate risk assessments focused on physical assets (85%) and on-site operations and people (66%). However, many organizations overlook system-level risks such as critical infrastructure dependencies (45%) and supplier vulnerabilities (43%). This is in line with findings from Marsh Risk and the Inter-American Development Bank's 2025 report Resilience Now: Closing the Adaptation Gap in Latin America and the Caribbean, which emphasized the need to scale integrated adaptation approaches, moving beyond isolated projects toward programmatic pathways that combine asset-level infrastructure upgrades with system-level resilience measures like ecosystem restoration.

> "In 2025, we found that most organizations' climate risk assessments focussed on physcial assets, and on-site operations and people."

Source: Marsh Climate Adaptation Survey

**Below:** *Marsh Risk and the Inter-American Development Bank's 2025 report Resilience Now: Closing the Adaptation Gap in Latin America and the Caribbean.*



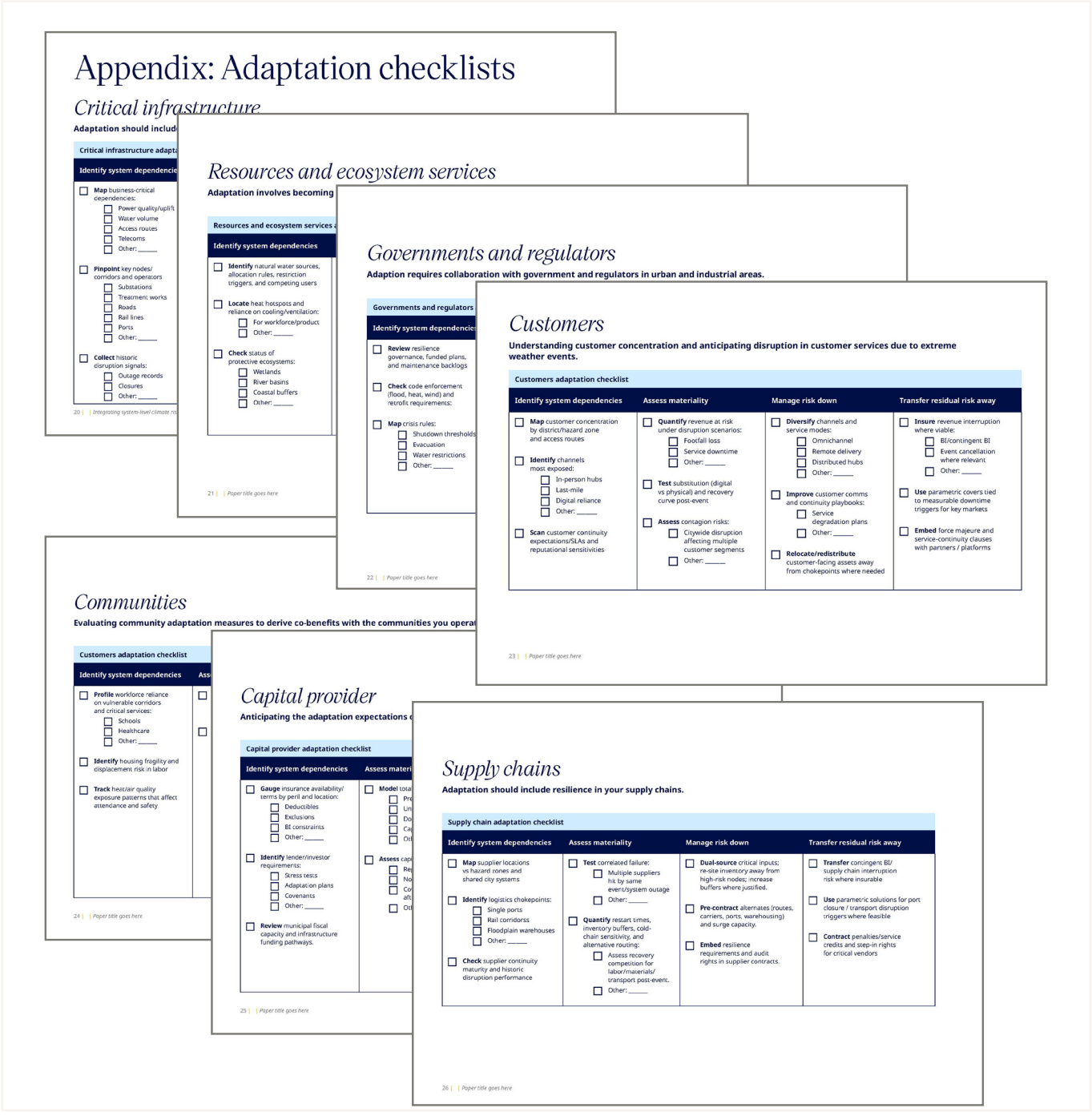
# 3

# An approach for organizations to address system-level risk

To move beyond awareness to action, organizations need a repeatable, decision-oriented process. We use a four-step approach: **identify** system dependencies; **assess** materiality; **manage** risk down; and **transfer** residual risk away (where possible). This approach is iterative and should be embedded into location strategy, procurement, capital allocation, and enterprise risk management.

We have created practical checklists aligned to each system-level component that organizations operating in urban and industrial areas can use. The checklists are designed to be actionable for risk managers and other risk owners within organizations, as illustrated in Figure 2 (see the Appendix for all checklists).

**Figure 2. Checklists for system-level adaptation:**



# 4

# What does addressing system-level risk look like in practice? Four lessons from around the world

A growing number of case studies are emerging that bring to life the checklists for system-level adaptation outlined in section 3. We highlight four lessons, illustrated by case studies from around the world, that show how organizations can address system-level risks.

# Lesson 1: When considering strategic investments in urban and industrial areas, treat infrastructure as a strategic risk, not just a background service.

## Case study: Malaysia's SMART tunnel

The SMART Tunnel in Kuala Lumpur is a dual-purpose piece of infrastructure designed to address climate adaptation and urban resilience by the Malaysian government. Under normal conditions, it functions as a motorway, but during heavy rainfall, it diverts stormwater away from the city center, thereby reducing the risk of flash flooding. This approach helps the city cope with increasingly intense rainfall while limiting disruption to transport and economic activity. Crucially, its resilience lies not only in engineering but in system-level design: clear operating triggers, rapid mode-switching, and coordination across transport, water, and emergency systems to prevent cascading failures and enable faster recovery.


The SMART Tunnel shows how resilient infrastructure can act as a mechanism to attract and retain organizations considering their system-level climate risks.

## Lesson 2: When engaging with local authorities or infrastructure operators, ask how climate risk is being embedded into planning, procurement, supply chains, and long-term maintenance.

# Case study: Public-private partnerships for integrated small and medium businesses and municipal adaptation planning

In Turin, Italy, a public-private partnership (PPP) involving insurers, local authorities, and small and medium-sized enterprises (SMEs) was formed to build adaptation capacity. The partnership developed company adaptation action plans for SMEs, as well as an integrated district adaptation plan for a pilot area within Turin. SMEs have been using an online risk assessment tool developed as part of the PPP to assess their vulnerability and design their adaptation plans. The PPP was scaled to ten other Italian cities, and SMEs continue to use the online climate risk tool.

## Lesson 3: When operating in urban "hotspots" or where suppliers and logistics routes concentrate, map supply chain dependencies and test plausible cascade pathways.

# Case study: Navigating supply chain risks with Sentrisk

Ports worldwide are vulnerable to operational disruptions from blocked waterways, natural disasters, epidemics, and riots, among other factors. Port cities are particularly at risk because multiple organizations share the same critical nodes and rely on the same local enabling conditions—channels, road and rail links, power and water utility connections, labor and housing capacity, emergency services, and nearby protective ecosystems. When those place-specific infrastructure and ecosystem conditions are stressed or fail, disruption propagates across all port users, directly impacting suppliers with knock-on effects for businesses and customers awaiting the transported goods.


Marsh Risk and Oliver Wyman have supported organizations operating in port cities (such as port owners and cargo shippers) in managing supply chain risks through the Sentrisk tool. Sentrisk enables stakeholders to identify and map supply chain risks, such as critical upstream suppliers and potential vulnerabilities, to support the development of robust contingency plans. This enables organizations to evaluate transport routes and infrastructure vulnerabilities, allowing them to diversify suppliers, reroute components, or use insurance products to mitigate potential losses.

Lesson 4: When considering where to build and invest, consider whether city-focused insurance products, such as parametric solutions, risk pools, or blended finance structures, can provide rapid liquidity to support the continuity and recovery of shared infrastructure.

## Case study: Risk pooling and city insurance with the Urban Infrastructure Insurance Facility (UIIF) model

In Latin America and the Caribbean, the Urban Infrastructure Insurance Facility (UIIF), led by ICLEI and supported by Marsh Risk and Guy Carpenter, provides a model for embedding risk transfer into system-level resilience. Organizations can access rapid liquidity after events thanks to risk pooling across cities, which helps diversify exposure.

# 5

# Conclusion: System-level risk management as a core capability for urban and industrial investment

As climate impacts intensify, organizations' exposure in cities will likely be shaped less by whether individual assets are hardened and more by the resilience of their entire ecosystems.

A clear risk management process across system-level risks can help organizations move from abstract concerns to concrete actions.

System-level risks — cascading failures, compound hazards, infrastructure fragilities, and socio-economic stresses — are increasingly central to operational continuity, supply chain reliability, insurability, and long-term value.

The good news is that system-level risk can be managed. A clear risk management process across system-level risks, can help organizations move from abstract concerns to concrete actions. Organizations can start with the four-step approach to identify, assess, manage and transfer risks, using the checklists provided in the Appendix.

This does not happen in isolation. The growing body of city resilience initiatives, analytical tools, and risk-financing approaches provides practical entry points for engagement, as highlighted in the key lessons from around the world. In each case, organizations can collaborate with local authorities and utilities on risk assessments, resilience investment plans, maintenance regimes, and how climate risk is embedded into procurement, capital planning, and performance standards. Equally, organizations can share open and decision-useful risk information with relevant stakeholders.

For Marsh Risk clients, integrating system-level risk management into urban investment decisions is not only a defensive move — it is a route to better decision quality, stronger stakeholder relationships, and a more resilient platform for growth in the economy of the future.

# Acknowledgements

A COP30 workshop in collaboration with TED Countdown provided insights that were used to inform this paper.

## References

1. World Bank. Urban Development Overview (cities account for ~80% of global GDP).
2. UN SDG Indicators Report (Goal 11): cities contribute more than 80% of global GDP; >70% emissions.
3. IPCC AR6 WGII Chapter 6: Cities, settlements and key infrastructure (compound and cascading risks in urban areas).
4. https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2025/
5. https://www.weforum.org/publications/building-economic-resilience-to-the-health-impacts-of-climate-change/
6. Arup. City Resilience Index (overview and PDF).
7. Lloyd's. City Risk Index 2015–2025 (GDP@Risk).
8. Rockefeller Foundation / 100 Resilient Cities and City Resilience Framework resources.
9. C40 Cities network (city-led climate action programmes).
10. CDP (2025) Showcasing Cities' Investment Needs for Aligned Multilevel Climate Action (CDP-ICLEI Track).
11. Global Covenant of Mayors (2025) press release: cities seek record $105bn for climate projects.
12. Climate Policy Initiative (2021) Building Climate Resilience in Cities Through Insurance.
13. Cities Climate Finance Leadership Alliance (2025) Mobilizing Private Capital for Resilient and Low-Carbon Cities; plus State of Cities Climate Finance 2024.
14. NYC Lower Manhattan Coastal Resiliency / Battery Coastal Resilience project pages.
15. Inter-American Development Bank (2025) Resilience Now: Closing the Adaptation Gap in Latin America and the Caribbean.
16. Urban Infrastructure Insurance Facility (UIIF) overview site.
17. EEA Climate-ADAPT (2025) Adaptation option: PPPs for adapting and maintaining infrastructure and services.

18. Islam, T.A. (2022) A Business Approach to Climate Adaptation in Local Communities (OSTI).

19. Carnegie Endowment (2025) Managing Climate Risk: Implications for Local Governments.

20. Reuters (2025) reporting on climate preparedness and city competitiveness (as cited in outline).

21. World Economic Forum (2024; 2025) stories on climate-resilient cities and investing in urban resilience.

22. Deloitte Insights (2021) Building climate-resilient cities.

23. Insurance company supporting adaptation action in small and medium size enterprises in Turin (Italy) | Case studies | Discover the key services, thematic features and tools of Climate-ADAPT Climate-ADAPT.

# Appendix: Adaptation checklists

## Critical infrastructure

**Adaptation should include resilience to critical infrastructure failure.**

**Critical infrastructure adaptation checklist**

### Identify system dependencies

- ☐ **Map** business-critical dependencies:
  - ☐ Power quality/uplift
  - ☐ Water volume
  - ☐ Access routes
  - ☐ Telecoms
  - ☐ Other: _____
- ☐ **Pinpoint** key nodes/ corridors and operators
  - ☐ Substations
  - ☐ Treatment works
  - ☐ Roads
  - ☐ Rail lines
  - ☐ Ports
  - ☐ Other: _____
- ☐ **Collect** historic disruption signals:
  - ☐ Outage records
  - ☐ Closures
  - ☐ Other: _____

### Assess materiality

- ☐ **Stress-test** dependencies vs hazards (flood, storm, wildfire), and compound events
- ☐ **Quantify** time-to-failure and time-to-recovery, including restart constraints
- ☐ **Model** cascade pathways:
  - ☐ Power outage
  - ☐ Water pump failure
  - ☐ Production shutdown
  - ☐ Other: _____

### Manage risk down

- ☐ **Build** redundancy:
  - ☐ Dual feeds
  - ☐ Backup power and fuel
  - ☐ Alternate water sources
  - ☐ Comms failover
  - ☐ Other: _____
- ☐ **Plan** continuity:
  - ☐ Alternate sites
  - ☐ Routing plans
  - ☐ Workforce access protocols
  - ☐ Supplier reroutes
  - ☐ Other: _____

### Transfer residual risk away

- ☐ **Structure business interruption** (BI)/ contingent covers aligned to interruption drivers:
  - ☐ Utilities/denial of access
  - ☐ Other: _____
- ☐ **Consider** parametric triggers where measurable:
  - ☐ Outage duration
  - ☐ Flood depth
  - ☐ Windspeed
  - ☐ Other: _____
- ☐ **Embed** resilience requirements in contracts/ SLAs with operators and key vendors.

# *Resources and ecosystem services*

**Adaptation involves becoming resilient to impacts on key resources and the ecosystem services you depend on.**

**Resources and ecosystem services adaptation checklist**

| Identify system dependencies | Assess materiality | Manage risk down | Transfer residual risk away |
|---|---|---|---|
| ☐ **Identify** natural water sources, allocation rules, restriction triggers, and competing users<br><br>☐ **Locate** heat hotspots and reliance on cooling/ventilation:<br>☐ For workforce/product<br>☐ Other: _____<br><br>☐ **Check** status of protective ecosystems:<br>☐ Wetlands<br>☐ River basins<br>☐ Coastal buffers<br>☐ Other: _____ | ☐ **Project** water scarcity/ heat trends and operational thresholds:<br>☐ Curtailment points<br>☐ Other: _____<br><br>☐ **Test** sensitivities:<br>☐ Water intensity<br>☐ Cooling loade<br>☐ Substitution options<br>☐ Other: _____<br><br>☐ **Assess** dependency on regional inflows of raw materials and upstream hazards | ☐ **Reduce** resource intensity:<br>☐ Water efficiency<br>☐ Reuse<br>☐ Process changes<br>☐ Cooling retrofits<br>☐ Other: _____<br><br>☐ **Diversify** sources:<br>☐ Secondary water<br>☐ Storage<br>☐ Alternative inputs<br>☐ Backup suppliers<br>☐ Other: _____<br><br>☐ **Collaborate** on watershed / urban cooling initiatives where feasible | ☐ **Transfer** operational interruption risk via parametric products:(e.g., drought indices where relevant)<br><br>☐ **Insure** key equipment/ process exposures tied to heat/water constraints |

# *Governments and regulators*

**Adaptation requires collaboration with government and regulators in urban and industrial areas.**

**Governments and regulators adaptation checklist**

| Identify system dependencies | Assess materiality | Manage risk down | Transfer residual risk away |
|---|---|---|---|
| ☐ **Review** resilience governance, funded plans, and maintenance backlogs<br><br>☐ **Check** code enforcement (flood, heat, wind) and retrofit requirements:<br><br>☐ **Map** crisis rules and regulations:<br>☐ Shutdown thresholds<br>☐ Evacuation<br>☐ Water restrictions<br>☐ Other: _____ | ☐ **Evaluate** execution risk: likelihood that planned upgrades are delivered and maintained<br><br>☐ **Assess** regulatory volatility post-event:<br>☐ Policy shifts<br>☐ Permitting constraints<br>☐ Other: _____<br><br>☐ **Test** operational impact of crisis actions:<br>☐ Closures<br>☐ Curfews<br>☐ Access restrictions<br>☐ Other: _____ | ☐ **Engage** early with city/utility stakeholders on dependencies and recovery priorities.<br><br>☐ **Design** for compliance headroom:<br>☐ Build above minimum code<br>☐ Plan for tightening<br>☐ Other: _____<br><br>☐ **Pre-agree** response protocols:<br>☐ Access letters<br>☐ Essential worker status<br>☐ Comms<br>☐ Other: _____ | ☐ Leverage political risk transfer solutions where appropriate:<br>☐ For abrupt change impacts<br>☐ Other: _____<br><br>☐ **Transfer** loss from denial of access where insurable<br><br>☐ **Contract** for flexibility:<br>☐ Lease clauses<br>☐ Termination rights<br>☐ Step-in rights<br>☐ Other: _____ |

# *Customers*

**Understanding customer concentration and anticipating disruption in customer services due to extreme weather events.**

**Customers adaptation checklist**

| Identify system dependencies | Assess materiality | Manage risk down | Transfer residual risk away |
|---|---|---|---|
| ☐ **Map** customer concentration by district/hazard zone and access routes<br><br>☐ **Identify** channels most exposed:<br>☐ In-person hubs<br>☐ Last-mile<br>☐ Digital reliance<br>☐ Other: _____<br><br>☐ **Scan** customer continuity expectations/SLAs and reputational sensitivities | ☐ **Quantify** revenue at risk under disruption scenarios:<br>☐ Footfall loss<br>☐ Service downtime<br>☐ Other: _____<br><br>☐ **Test** substitution (digital vs physical) and recovery curve post-event<br><br>☐ **Assess** contagion risks:<br>☐ Citywide disruption affecting multiple customer segments<br>☐ Other: _____ | ☐ **Diversify** channels and service modes:<br>☐ Omnichannel<br>☐ Remote delivery<br>☐ Distributed hubs<br>☐ Other: _____<br><br>☐ **Improve** customer comms and continuity playbooks:<br>☐ Service degradation plans<br>☐ Other: _____<br><br>☐ **Relocate/redistribute** customer-facing assets away from chokepoints where needed | ☐ **Insure** revenue interruption where viable:<br>☐ BI/contingent BI<br>☐ Event cancellation where relevant<br>☐ Other: _____<br><br>☐ **Use** parametric covers tied to measurable downtime triggers for key markets<br><br>☐ **Embed** force majeure and service-continuity clauses with partners / platforms |

# *Communities*

**Evaluating community adaptation measures to derive co-benefits with the communities you operate in.**

**Communities adaptation checklist**

| Identify system dependencies | Assess materiality | Manage risk down | Transfer residual risk away |
|---|---|---|---|
| ☐ **Profile** workforce reliance on vulnerable corridors and critical services:<br>☐ Schools<br>☐ Healthcare<br>☐ Other: _____<br><br>☐ **Identify** housing fragility and displacement risk in labor<br><br>☐ **Track** heat/air quality exposure patterns that affect attendance and safety | ☐ **Estimate** absenteeism / productivity impacts under heat/flood/smoke scenarios<br><br>☐ **Assess** recovery constraints:<br>☐ Housing loss<br>☐ Childcare disruption<br>☐ Transit outages<br>☐ Other: _____ | ☐ **Strengthen** workforce continuity:<br>☐ Remote work triggers<br>☐ Flexible shifts<br>☐ Safe transport options<br>☐ Other: _____<br><br>☐ **Support** resilience:<br>☐ Cooling measures<br>☐ Health protocols<br>☐ Emergency support programs<br>☐ Other: _____<br><br>☐ **Coordinate** with local services/providers:<br>☐ Workforce comms<br>☐ Shelter<br>☐ Medical plans<br>☐ Other: _____ | ☐ **Transfer** people-related interruption risks where possible:<br>☐ Accident/health programes<br>☐ Travel/medical<br>☐ Event covers<br>☐ Other: _____<br><br>☐ **Use** contingency budgeting/ contingent capital for workforce disruption periods<br><br>☐ **Contract** for surge labor and alternative service provision post-event |

# *Capital providers*

**Anticipating the adaptation expectations of your capital providers.**

**Capital provider adaptation checklist**

| Identify system dependencies | Assess materiality | Manage risk through targeted interventions and partnerships | Transfer residual risk through financial solutions |
|---|---|---|---|
| ☐ **Gauge** insurance availability/ terms by peril and location:<br>☐ Deductibles<br>☐ Exclusions<br>☐ BI constraints<br>☐ Other: _____<br><br>☐ **Identify** lender/investor requirements:<br>☐ Stress tests<br>☐ Adaptation plans<br>☐ Covenants<br>☐ Other: _____<br><br>☐ **Review** municipal fiscal capacity and infrastructure funding pathways. | ☐ **Model** total cost of risk:<br>☐ Premium trends<br>☐ Uninsured loss<br>☐ Downtime<br>☐ Capex requirements<br>☐ Other: _____<br><br>☐ **Assess** capital access risk:<br>☐ Repricing<br>☐ Non-renewal<br>☐ Covenant tightening after events<br>☐ Other: _____ | ☐ **Optimise risk appetite and footprint concentration:**<br>☐ De-risking hotspots, diversification<br><br>☐ **Invest in resilience measures that improve insurability/bankability**<br>☐ Hardening, redundancy<br><br>☐ **Prepare disclosure and governance to meet finance expectations**<br>☐ Credible adaptation roadmap | ☐ **Structure** layered risk financing<br>☐ Retentions, captives, parametric, contingent capital<br><br>☐ **Use** resilience-linked financing where available<br>☐ Incentives tied to upgrades |

# *Suppliers*

**Adaptation should include resilience in your supply chains.**

**Suppliers adaptation checklist**

| Identify system dependencies | Assess materiality | Manage risk down | Transfer residual risk away |
|---|---|---|---|
| ☐ **Map** supplier locations vs hazard zones and shared city systems<br><br>☐ **Identify** logistics chokepoints:<br>☐ Single ports<br>☐ Rail corridorss<br>☐ Floodplain warehouses<br>☐ Other: _____<br><br>☐ **Check** supplier continuity maturity and historic disruption performance | ☐ **Test** correlated failure:<br>☐ Multiple suppliers hit by same event/system outage<br>☐ Other: _____<br><br>☐ **Quantify** restart times, inventory buffers, cold-chain sensitivity, and alternative routing:<br>☐ Assess recovery competition for labor/materials/ transport post-event.<br>☐ Other: _____ | ☐ **Dual-source** critical inputs; re-site inventory away from high-risk nodes; increase buffers where justified.<br><br>☐ **Pre-contract** alternates (routes, carriers, ports, warehousing) and surge capacity.<br><br>☐ **Embed** resilience requirements and audit rights in supplier contracts. | ☐ **Transfer** contingent BI/ supply chain interruption risk where insurable<br><br>☐ **Use** parametric solutions for port closure / transport disruption triggers where feasible<br><br>☐ **Contract** penalties/service credits and step-in rights for critical vendors |

**About Marsh Risk**

Marsh Risk is a business of Marsh (NYSE: MRSH), a global leader in risk, reinsurance and capital, people and investments, and management consulting, advising clients in 130 countries. With annual revenue of over $24 billion and more than 90,000 colleagues, Marsh helps build the confidence to thrive through the power of perspective. For more information about Marsh Risk, visit marsh.com, or follow us on LinkedIn and X.





26119132-GL