

通用机场韧性规划：构建自驱动恢复力

--Creating Self-Directed Resiliency Plans for General Aviation Airports

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通用机场运营、规划与管理

2025年11月18日

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通用机场韧性规划：构建自驱动恢复力

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韧性规划背景与意义

为通用航空机场制定自主韧性计划是一套指南和工具包，旨在帮助通用机场在维持运营的同时，应对、适应各种冲击和压力源，并且及时恢复。

本文为通用航空机场创建了一个的工具，用于识别冲击和压力源、进行风险评估并确定对机场的潜在影响。

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【1】韧性是“为预期的危险做好准备，适应不断变化的条件，并承受和迅速从中断中恢复的能力。”
【2】冲击和压力可能是短期(冲击)或长期(压力)干扰或压力，破坏机场稳定并威胁安全、保障、基础设施、员工和运营连续性。

极端天气与经济冲击

近年来，美国极端天气事件频发，通航机场面临巨大挑战。例如，[illegible]河畔机场八年五淹，COVID-19疫情导致飞行学校停课又爆满，燃料价格单日跳涨[illegible]%。这些事件凸显了韧性规划的紧迫性。

通航机场的关键作用

通航机场作为美国乡村唯一生命线，大[illegible]纽溢出缓冲区、消防与疫苗空投基地，一旦停摆，社区物流、医疗与应急链条即刻断裂。其[illegible]要性不言而喻。

政策与资金支持

联邦新版[illegible]韧性行动计划将通航纳入关键基础设施，配套资金窗口已开。不提前规划即错失修复与强化黄金期，机场需抓住机遇，提升韧性。

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韧性工具包概述



工具包为通用[illegible]场提供以下服务：

1、确[illegible]适用于机场的冲击和压力因素并了解如[illegible]对；

2、因地制宜，寻求结合各种行动以提高效率和优化资源；

3、优化有限的资金、人员以及其他资源；

4、借鉴类似民航运输机场的经验教训；

5、在倡导资源时，向社区传达通用航空机场的关键功能。

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韧性工具包概述—如何将韧性思想融入规划中



联邦紧急事务管理局的国家防范系统流程



韧性工具包

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韧性工具包概述—如何将韧性思想融入规划中



Table 2. Self-Directed Resiliency Toolkit tools and resources.

Step	Tool	Resource
Start	A	Resource Review
1	B	Overview of Identified Shocks and Stressors
	C	Risk-Assessment Analysis Tool
2	D	Mitigating Actions to Address Shocks and Stressors
		Case Studies
3	F	Emergency Communications Plan Template
	G	Airport Emergency Plan Template
	H	Incident Mitigation Plan Template
	I	Stakeholder Engagement Checklist Template
	J	Incident Command System Template
4	K	Communications and Collaboration Guidelines
	L	Aircraft Rescue and Firefighting Letter of Agreement Template
5	M	Airport Resiliency Stress-Test Exercise-in-a-Box
6	N	Incident After-Action and Corrective-Actions Template

右表为每个步骤对应工具包中的工具、资源和信息的相关部分。

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韧性工具包概述—如何将韧性思想融入规划中



起点：资源审查

该工具提供74种用于韧性规划的资源，包括关键要点、注释和关键主题，以帮助用户缩小搜索范围。

Table 3. Starting point tool, resource, and description.

Tool	Resource	Description
A	Resource Review	This tool provides more than 70 resources for resilience planning. It includes key takeaways, notes, and key themes to help users narrow their searches.

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第1步：识别和评估风险

了解并持续掌握机场所面临的冲击和压力因素，有助于建立并维持韧性规划工作。此步骤包括风险评估，以收集预测冲击和压力因素的后果或影响（见表4）。

Table 4. Step 1 tools, resources, and descriptions.

Tool	Resource	Description
B	Overview of Identified Shocks and Stressors	This resource provides an overview of relevant shocks and stressors for GA airports based on interviews conducted with GA airports and additional research.
C	Risk-Assessment Analysis Tool	This tool is used to identify shocks and stressors for users' airports, prioritize them, and review their impacts.

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第2步：评估能力需求

通过利用风险评估的结果和预期成果，机场可以确定应对冲击和压力所需的能力类型和水平。评估预防、保护、缓解、响应和恢复方面所需的能力，将使机场能够识别需要弥补的差距以及维持现有能力的要求（见表5）。

Table 5. Step 2 tools, resources, and descriptions.

Tool	Resource	Description
D	Mitigating Actions to Address Shocks and Stressors	This resource provides best practices, strategies, and mitigating actions gathered during the interviews with GA airports to address shocks and stressors.
E	Case Studies	The case studies provide more in-depth information from GA airports' best practices to further identify resources needed to address shocks and stressors.

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第3步：构建和维持能力

评估能力需求后，可以分析现有和所需的能力，以确定差距。分析完成后，机场应确定如何在有限的资源下解决和构建能力（表6）。

Table 6. Step 3 tools, resources, and descriptions.

Tool	Resource	Description
F	Emergency Communications Plan Template	This tool provides a template for compiling contact information for contacts with whom airport personnel communicate daily and during emergencies.
G	Airport Emergency Plan Template	This tool is intended to aid in the methodology and approach to preparing for, responding to, and recovering from shocks and stressors.
H	Incident Mitigation Plan Template	This tool is intended to aid in the methodology and approach to identifying potential risks and developing strategies to protect staff, tenants, stakeholders, and property from similar events.
I	Stakeholder Engagement Checklist Template	This tool is meant to aid in the methodology and approach to interacting and communicating with stakeholders.
J	Incident Command System Template	This resource provides an overview of the Incident Command System and a template to build the structure when an incident occurs.

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第4步：规划交付能力

计划的制定应与现有社区利益相关者建立联系，并扩展到其他利益相关者，以鼓励社区参与。工具包内容提供了社区参与的技术建议和模板。机场还应纳入已实施的当前活动（例如与社区合作举办的活动），以帮助最大限度地降低经济风险。有关步骤4的工具和说明，请参见表7。

Table 7. Step 4 tools, resources, and descriptions.

Tool	Resource	Description
K	Communications and Collaboration Guidelines	This resource is meant to aid in the methodology and approach to communicating and coordinating with internal and external stakeholders before, during, and after an incident.
L	Aircraft Rescue and Firefighting Letter of Agreement Template	This resource is meant to aid in the approach to communicating and coordinating with air rescue and firefighting first-responder personnel during and after an incident.

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第5步：验证功能

衡量交付能力的进展可以决定机场应如何以及在何处分配资源。这种进展衡量可以通过定期演练和评估来测试和验证计划、培训和程序。

Table 8. Step 5 tool, resource, and description.

Tool	Resource	Description
M	Airport Resiliency Stress-Test Exercise-in-a-Box	This tool aims to provide resources for GA airports to conduct a resilience stress test of emergency plans, policies, and procedures.

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第6步：审核与更新

定期审查和更新所有计划、政策和程序至关重要。审查应基于当前的风险评估，并使用验证过程中收集的信息。

Table 9. Step 6 tool, resource, and description.

Tool	Resource	Description
N	Incident After-Action and Corrective-Actions Template	This tool provides a template for incident after-action meetings and a corrective-actions template.

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韧性工具包概述

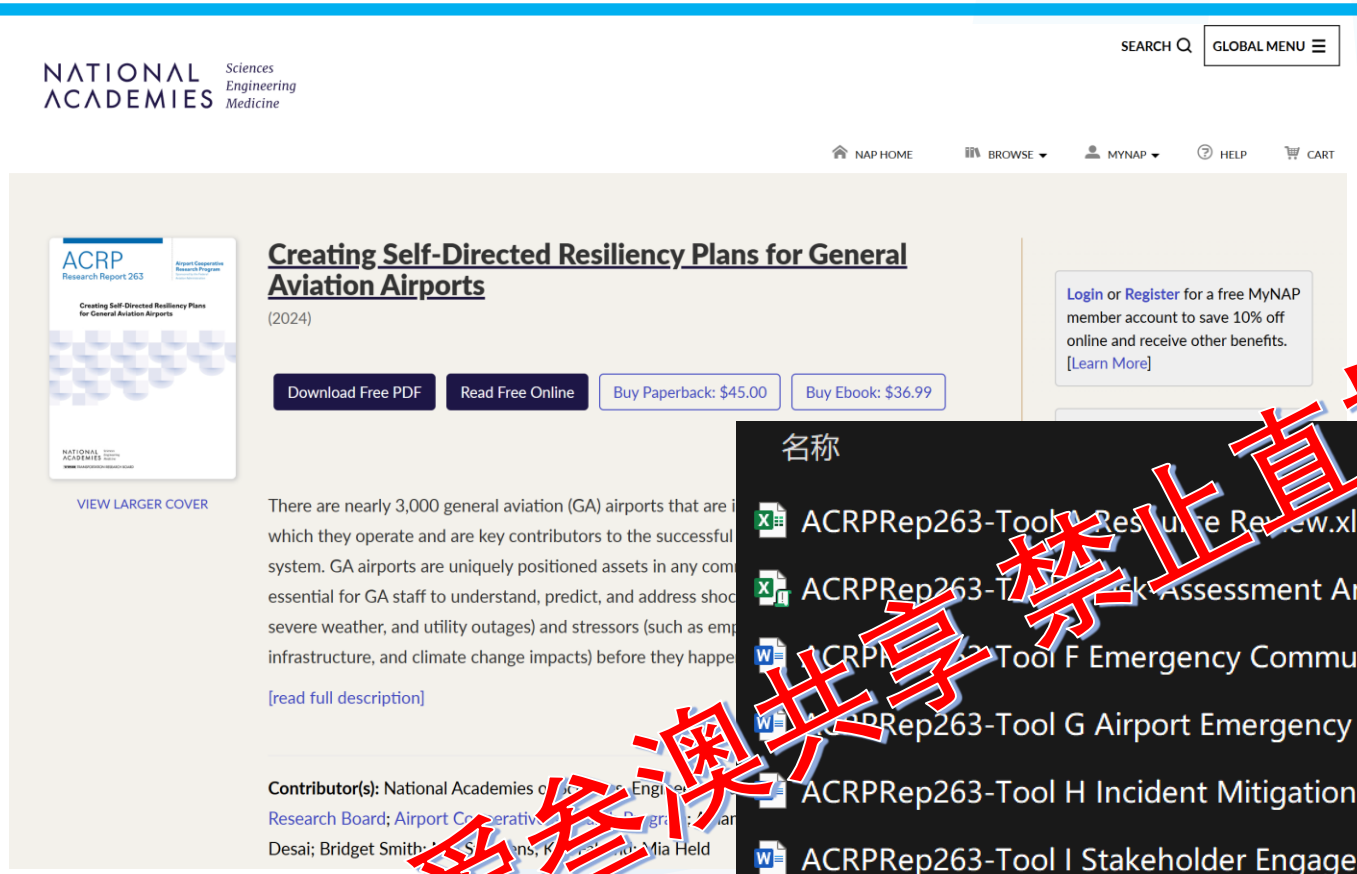


以国家备灾系统六步为骨架，工具包提供资源清单、风险矩阵、缓解措施、案例库、应急模板、演练盒、事后复盘表共14份可编辑文件，形成完整的韧性规划闭环。

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各工具详细介绍

https://nationalacademies.org/



名称	类型	大小
ACRPRep263-Tool A Resource Review.xlsx	Microsoft Excel 工作表	83 KB
ACRPRep263-Tool B Risk Assessment Analysis Tool.xlsm	Microsoft Excel 启用宏的工作表	196 KB
ACRPRep263-Tool F Emergency Communications Plan Template.docx	Microsoft Word 文档	86 KB
ACRPRep263-Tool G Airport Emergency Plan Template.docx	Microsoft Word 文档	100 KB
ACRPRep263-Tool H Incident Mitigation Plan Template.docx	Microsoft Word 文档	59 KB
ACRPRep263-Tool I Stakeholder Engagement Checklist Template.docx	Microsoft Word 文档	81 KB
ACRPRep263-Tool J Incident Command System Template.docx	Microsoft Word 文档	95 KB
ACRPRep263-Tool L Letter of Agreement Template.docx	Microsoft Word 文档	80 KB
ACRPRep263-Tool M Airport Resiliency Stress-Test Exercise-in-a-Box.docx	Microsoft Word 文档	174 KB
ACRPRep263-Tool N Incident After-Action Template.docx	Microsoft Word 文档	86 KB

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各工具详细介绍-工具A

A资源审查

提供74种用于弹性规划的资源，包括关键要点、注释和关键主题，以帮助用户缩小搜索范围。

	Resource Reviewed	Document Date	Document Author	Targeted Audience	Resource (M...)	Resource Type	Abstract/Summary for Literature Review
1	Planning for Infrastructure Resilience	Dec-19	DeAngelis, Briel, and Lauer, APA	Airport Sponsors, Stakeholders		Report	Threats to public infrastructure exist from sea level rise, coastal storms, and extreme precipitation. However there are many opportunities for resilience. Communities must assess long-term needs and risks, integrate resilience into local plans and capital improvements, and work to find sources of funding.
2	ACC Planning and Environmental Committee White Paper: Rethinking Airport Resiliency in the Aftermath of COVID-19	21	...nd Le... ACI	Airport Sponsors	Most Valuable	Report	Financial resilience is important in mitigating risk exposure. Airports can include resilience measures in project scopes, develop non-aeronautical uses, evaluate insurance options, perform robust cost/benefit analyses for each investment, and pursue sustainability goals to become more resilient against all risks.
3	ACRP Report 160:Addressing ... Weather Impacts on Airpo...	2016	ACRP	Airport Sponsors		Online Tool/Guide	The AWARE Toolkit is a useful software program to evaluate exposure information, readiness, and impact tracking. The model is set up in greater detail for large airports but can be used for small GA airports as well.
4	...RP Synthe... 11: ...ractices in Airport E... gency Plans	2021	Murphy, Delventhal, Kline, and Rand, ACRP	Airport Sponsors, Stakeholders		Report	The research focuses on a survey of airports surrounding AEPs and their effectiveness. AEPs are often rigid documents that do not have an all-hazards approach, often annexes or other supplemental documents are needed to address specific threats relevant to the individual airport. The major success of updating AEP is communication/knowledge exchange with stakeholders. Contains AEP considerations specific to GA airports.
5	Airport Emergency Plan Development Tool	Oct-20	ACRP	Airport Sponsors		Online Tool	The online Airport Emergency Plan (AEP) Development Tool produces airport-specific AEPs in a format consistent with the Federal Aviation Administration's Advisory Circular 150/5200-31C titled, Airport Emergency Plan (AEP). The program uses a template to ensure compliance with FAA regulations while incorporating airport-specific information.
6	ACRP Research Report 222: Collecting and Sharing of Operations and Safety Data	2020	ACRP	Airport Sponsors		Report	The collection and sharing of data is essential in an airport's risk management process. Collecting operations data provides the means for process improvement, resulting in reduced operations costs and reduced maintenance costs. To enable better analysis and sharing of data, an important consideration for data collection is a need for publicly available operations and safety databases accessible to the aviation industry. Airport administration and stakeholders should continuously share and monitor a range of data points.
7	ACRP WebResource 8: Integrating Social Media with Emergency Management at Airports	2020	ACRP	Airport Sponsors/General Interest		Presentation/Guide	Social media can complement or complicate emergency management efforts. Listening, Engagement, Publishing, and Reporting are the cornerstones of SM management functions. Mitigation, Preparedness, Response, and Recovery are the four central phases of emergency management.
8	Update of Security 101: A Physical Security and Cybersecurity Primer for Transportation Agencies	2020	NCHRP	Airport Sponsors		Report	Following a discussion of physical security and cybersecurity strategies, Chapter 6 deals with infrastructure protection and resilience. Resilience can be defined as "the ability to prepare and plan for, absorb, recover from, or more successfully adapt to

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B已识别的冲击和压力源概述

要通过有效的韧性规划来维护通用航空机场的服务和能力，首先需要根据机场运营的地理、区域和人口背景，识别可能影响机场的冲击和压力因素。

包括日常事件(例如强风暴、洪水或冬季天气)，以及灾难性事件(例如地震、洪水、大面积野火或强飓风)。

还要应对人为和运营方面的冲击和压力，包括网络攻击、断电、经济衰退、飞行员短缺、公共事件问题、交通事故、政治问题或工业灾害。

Table B-1. Shocks and stressors.

Category	Shock/Stressor
Economic	Fuel price increases
	Financial stress/resilience issues
	Federal funding opportunities
Environmental	Severe weather
	Flooding
	Winter storms
	Hurricanes
	Tornadoes
	Earthquakes
	Drought
	Wildfires
	Volcanic eruption
	Tsunami
Operational	Political issues (local, state, national)
	Pilot shortages
	Border security
	Terrorist threats/attacks
	Cyberattacks/cyberterrorism
	Transportation incidents
	Airport security
	Power outage
	Industrial disasters
	Aging infrastructure
	Construction projects
	VIP visits
Social	Human pandemic
	Personnel issues

Source: ACRP Research Team GA airport interviews and Toolkit Pilot, 2022.

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C风险评估分析

旨在帮助通用航空机场审查和了解可能影响其日常运营的冲击和压力因素，对其进行优先排序，并评估其影响。

1、“冲击与压力因素”标签提供了冲击和压力因素的列表，其中包括威胁类别、受影响的地理区域、描述以及可能受影响的FAA区域。该列表还可以筛选和排序，以选择特定的FAA区域。

2、在识别出影响机场的冲击和压力因素后，进入“风险评估”标签进行风险分析，并为每个冲击或压力因素进行优先排序。

3、最后，“潜在影响”标签允许查看识别的每个冲击或压力因素的影响。开始考虑已有或需要的能力，以应对机场冲击和压力因素带来的影响。

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C风险评估分析

风险识别

先用“冲击与压力源清单”勾选机场可能遭遇的27项风险，为后续评估提供基础数据。

Instructions:
Using the filter in Column G, select your FAA region and filter. Review ALL the shocks and stressors within your FAA region below to identify those that currently affect or may affect your airport in the future

Go To Risk Assessment

Shocks, Stressors, and Threats and Hazards of Concern

Additional Details

ID	Shock/Stressor Name	Category	Description	Geographic Location(s)	FAA Region(s) Affected
1	*Human Pandemic*	S[illegible]	[illegible]uman pandemic can devastate the workforce across the aviation community and cause travelers to reduce their travel drastically. Airports must help passengers feel safe while working with limited funds and personnel.	National	AEA ANM ASW ASO AGL AWP ANE AAL ACE
	[illegible]nqu[illegible]kes	Environmental	Earthquakes are no-notice incidents caused by the movement of tectonic plates and can cause severe damage to infrastructure and buildings. GA airports may have facilities impacted by an earthquake or need to manage airport operations when a quake has damaged critical infrastructure.	Pacific Northwest (Washington, Oregon, Idaho), California, Hawaii, Alaska, Central/South Regions (Missouri, Arkansas, Tennessee, Illinois, Kentucky),	ANM ACE ASO AWP AAL
3	*Flooding*	Environmental	Flooding events typically occur when dry land becomes inundated from the overflow of inland or tidal waters or rapid accumulation. Flooding is anticipated to increase dramatically in the coming decades. Airports near water sources or the coast are particularly likely to be affected.	National	AEA ANM ASW ASO AGL AWP ANE AAL ACE
			Winter storms are notice events that bury communities	Pacific Northwest, Midwest, East	ANM AGL

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C风险评估分析

风险评估

把选中项粘贴到“风险分析表”，按发生概率与影响程度1-5打分，自动生成风险等级热力图，直观呈现风险分布。

Instructions:

1.) Using the drop-down list in Column A, select all the shocks and stressors that were identified in the Shocks & Stressors tab

2.) Use the Risk Assessment Matrix on the right, assign a risk rating to each shock or stressor using the drop down list in Column B

3.) Identify a prioritization for each shock/stressor in Column C (numbering in chronological order), based on the determined risk rating (in Column B) with 1 being the most severe/probable (highest risk) which has the highest priority to be addressed.

4.) Sort the Shock and Stressor list, based on Column C prioritization. This should be sorted Smallest to Largest to put all shocks and stressors in the correct order for prioritization.

Go To Potential Impacts

EXAMPLE

Shock/Stressor	Risk Rating	Prioritization
Flooding	*High*	*1*
Pilot Shortages	*Medium*	*3*
Tornados	*Medium*	*4*
Winter Storms	*Low*	*2*

Shock/Stressor	Risk Rating	Prioritizati
Tornadoes	High	1
Flooding and/or Storm Surge	Serious	2
Drought	Medium	3
Earthquake (i.e. Cascadia Subduction Zone)	Low	4
Financial Stress/Resilience Issues	Medium	
Human Epidemic	Medium	

Risk Assessment Matrix

Probability \ Severity	Minor	Moderate	Significant	Severe
Very Likely	Medium	Serious	High	High
Likely	Low Med	Medium	Serious	High
Possible	Low Med	Medium	Serious	Serious
Unlikely	Low	Low Med	Medium	Serious

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C风险评估分析

缓解措施

针对红色区域，调用“缓解措施表”匹配最佳实践，例如跑道淹水对应“开槽+移动泵+预制板”组合，实现精准缓解。

Instructions:
1.) Review Impacts for each potential Shock or Stressor for your Airport. Focus on the shock(s) or stressor(s) that pose the greatest risk(s) based on your risk assessment.
2.) Delete the shocks and stressors columns that do not affect your airport (to delete a column click on the column at the top to highlight the entire column, right click to bring up the menu and select delete)
3.) Column E has not automatically summed how many shocks and stressors have the same impacts across the shocks and stressors left that you identified (the totals in this column are only correct after you delete the shocks and stressors columns that are not applicable to your airport)
4.) In Column E, total the number of shocks and stressors that would impact the airport facility across all the stressors and shocks that you selected. You can sort this column from greatest to least to see which impacts are more prevalaent across your shocks and stressors, therefore, helping to prioritize where resources should go to multisolve problems. This will help identify strategies, best practices, and mitigating actions to help consolidate efforts to multi-solve problems in Step 2, Estimating Capability Requirements and Step 3, Building and Sustainig Capabilities.

ID	Area	Expected Impacts	Earthquakes	Flooding	Winter Storms	Pilot Shortages	Hurricanes	Tornadoes
1	Infrastructure	Failure of the building envelope	10	Yes	Yes	Yes	Yes	Yes
2	Infrastructure	Foundation heave/damage	7	Yes			Yes	Yes
3	Infrastructure	Hail damage	3		Yes			Yes
4	Infrastructure	Building water damage- long-term (moisture, mildew,	7		Yes	Yes	Yes	
5	Infrastructure	Failure of HVAC system	8	Yes	Yes		Yes	
6	Infrastructure	Increased demand on HVAC system	8	Yes	Yes		Yes	
7	Infrastructure	External facility flooding	6	Yes	Yes	Yes	Yes	
8	Infrastructure	On-airfield debris	9	Yes	Yes		Yes	Yes
9	Infrastructure	Roof failure	7	Yes		Yes	Yes	Yes
10	Infrastructure	Facility damage from light	2					Yes
11	Infrastructure	Over	5				Yes	
12	Infrastructure	Incr	15	Yes	Yes	Yes	Yes	Yes
13	Infrastructure		6			Yes	Yes	Yes
14	Infrastructure	Inta	3					
15	Infrastructure	Runwa	9	Yes	Yes	Yes	Yes	Yes
16	Infrastructure	Increa	6	Yes				Yes
17	Infrastructure		13	Yes	Yes	Yes	Yes	Yes
18	Infrastructure	Damage/corrosion to underground infrastructure	7	Yes	Yes	Yes	Yes	Yes
19	Infrastructure	ge to integrity of surfaces and pavements	8	Yes	Yes		Yes	Yes
20	Infrastructure	Electrical failure	9	Yes			Yes	Yes
21	Infrastructure	Electrical fire	5	Yes			Yes	Yes
22	Infrastructure	Sewer overflow	6		Yes	Yes	Yes	
23	Infrastructure	Damage to airport transportation vehicles	11	Yes	Yes		Yes	Yes
24	Infrastructure	Reduced vegetation and increased erosion	3					
25	Infrastructure	Lightning strikes causing fires	2					Yes
26	Infrastructure	Increased weathering on facilities and equipment	7		Yes	Yes	Yes	Yes
27	Infrastructure	Reduced aircraft capacity	3			Yes		
28	Infrastructure	Delays to construction	9	Yes	Yes	Yes	Yes	Yes
29	Infrastructure	Failure of local utilities	13	Yes	Yes	Yes	Yes	Yes
30	Infrastructure	Loss of field lighting	12	Yes	Yes	Yes	Yes	Yes
31	Infrastructure	Loss of ATC (if applicable)	8	Yes			Yes	Yes
32	Aircraft	Takeoff delays	18	Yes	Yes	Yes	Yes	Yes
33	Aircraft	Re-routing of aircraft	15	Yes	Yes	Yes	Yes	Yes
34	Aircraft	Damage to planes in hangars and on tie-downs	11	Yes	Yes	Yes	Yes	Yes
35	Aircraft	Decreased visibility	9	Yes	Yes	Yes	Yes	Yes
36	Aircraft	Increase/Decrease in fuel consumption	4					
37	Aircraft	Increased air turbulence/changing wind patterns/optimum orientation changes/microburst	7	Yes		Yes	Yes	Yes
38	Aircraft	Aircraft damage	11	Yes	Yes	Yes	Yes	Yes
39	Aircraft	Impact to aircraft performance (Reduced braking/hydroplaning, etc.)	5		Yes	Yes	Yes	
40	General/Operational	Contagious disease/viral outbreaks	5	Yes	Yes		Yes	
41	General/Operational	Reduced availability of clean water	7	Yes	Yes		Yes	
42	General/Operational	Interruption of traffic flows to/from airport	18	Yes	Yes	Yes	Yes	Yes
43	General/Operational	Reduced throughput capacity	12	Yes	Yes		Yes	Yes

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D缓解冲击和压力的措施

研究团队在访谈中收集了以下冲击和压力因素及其相关的最佳实践和缓解措施。

能够帮助大家了解通用航空机场可能面临的挑战，并参考一些实用的最佳实践和缓解措施。

鼓励机场在其韧性规划中考虑实施这些相关的最佳实践和缓解措施。

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Table D-1. Shocks and stressors.

		Economic
Shock/Stressor	**Description**	**Best Practices/Mitigating Actions**
Fuel price increases	Inflation and global political situations have directly resulted in increased fuel prices, which directly affect airport operations when fuel prices unexpectedly rise. GA airports must manage rising costs to continue operations.	– Purchase fuel to keep prices low for customers for as long as possible (if applicable). – Create a fuel discount program for fuel purchased at a high volume to encourage customers to continue flying even with the high price of fuel. – Privatize fuel service. – Establish minimum standards that moderate fuel costs by fixed-base operator (FBO)/provider.
Financial stress/ Resilience issues	While funding may come from various sources, a number of GA airports rely on local taxes and income from airport operations, including fuel sales and tenant and hangar leases. As a result, GA airports are susceptible to economic fluctuations, which can impact the airport's ability to continue its success and uninterrupted operations.	– Diversify airport income sources regularly, including the consideration of nonaeronautical revenue sources. – Coordinate regularly with peer airports to understand alternative methods and best practices for increased revenue. – Maintain regular community outreach to ensure the value of the airport is clear to the local community. Community support of the airport is vital for continued financial success. Consider opportunities for airport-sponsored community events. – Document airport spending and keep a reserve available (recommended six months to a year of airport expenses) to cover critical expenditures in the event of short-term cuts to funding. – Update airport rates and fees on an annual basis to keep pace with market and inflation rates.
Federal funding opportunities	Opposite of the issues associated with the lack of funding, the COVID-19 pandemic has shown how the availability of federal relief in the form of stimulus, removal of local fund-matching requirements, or new grant opportunities have strained airports to prioritize eligible projects and initiatives and maximize available funding.	– Stay up-to-date on funding opportunities and understand the processes for procurement. – Understand obligations associated with funding types. – Maintain good relationships with the local FAA Airports District Office and state regulatory agency (DOT). – Develop and maintain an up-to-date Airport Capital Improvement Plan that can be a source of projects to be moved forward if funding became available.

(continued on next page)

E案例研究

全面准确地展现全国范围内的冲击、压力源和韧性活动。这些案例研究记录了机场为减轻冲击和压力源的影响而采取的一些最佳实践。

团队根据机场规模和复杂性、FAA地区、冲击和压力源以及当前的韧性规划工作等多项选择标准，选择了七家机场和阿拉斯加州立航空部作为案例。

Table E-1. Overview of case-study airports.

Airport Name	Airport Code	FAA Region	Airport Role	[illegible]	[illegible] Length* (FT)	Shocks and Stressors
St. Charles County Smartt Airport	SET	ACE	[illegible]	[illegible]	3,800	Flooding, winter storms, severe weather, human pandemic
Pine Bluff Regional Airport	[illegible]	ASW	Local	8,900	5,998	Aircraft incidents, fuel price increases, severe weather
[illegible] Airport	UZA	ASO	Regional	28,100	5,500	Personnel issues
Arlington Municipal Airport	AWO	ANM	Regional	67,080	5,332	Aircraft incidents, severe weather, human pandemic
Chennault Airport	CWF	ASW	Regional	18,914	10,702	Hurricanes
Phoenix Deer Valley Airport	DVT	AWP	National	402,444	8,196	Human pandemic, severe weather
Madison Municipal Airport	IMS	AGL	Local	15,650	5,000	Economic, personnel issues
Alaska Division of Statewide Aviation	Various	AAL	Various	Various	Various	Severe weather, infrastructure

*Note: For the purposes of this case-study report, annual operations and length of longest runway at the airport were

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圣查尔斯县斯马特机场

机场背景：

1、灾后恢复围绕着洪灾事件展开；
2、年度机场开放日和南瓜投放活动；
3、66号公路克尔维特俱乐部拉力赛；
4、进行军事演习。

机场历史；

冲击和压力：

1、洪水：由于靠近密西西比河，机场经常遭受洪水侵袭。在过去的8到9年间，机场共经历了五次洪水，其中四次为“常规”洪水，一次被列为特大洪水。
2、冬季风暴和恶劣天气：机场每年都会遭遇暴风雪和与高温相关的压力。
3、疾病大流行：COVID-19 大流行最初导致机场飞行学校的活动减少；然而，在下降之后圣查尔斯机场今年的学生人数继续大幅增加。

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圣查尔斯县斯马特机场

当前的做法和可用的资源：

遭遇洪水时，由于洪水影响了机场的垂直跑道，机场管理人员会关闭服务。

工作人员会使用以下额外的韧性工具和策略来应对洪水相关问题：

1、在主办公室放置一张小抄，上面显示河流高度和机场积水位置，以预测机场关闭情况；并警告租户在洪水发生前转移飞机；

2、制定在洪水期间升起T型机库门的程序，让水流过机库；

3、与一家清洁公司签订合同，要求其在洪水发生后 72小时内采取行动，清理该地区的淤泥和杂物，并用高压水枪冲洗建筑物；

4、维护最新的租户电子邮件联系人列表，并制定流程，在潜在洪水事件发生前定期以更高的频率发出警报，以通知租户他们可能需要采取行动。

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圣查尔斯县斯马特机场

经验教训：

根据以往事件带来的教训，圣查尔斯县斯马特机场的工作人员对运营、维护和规划实施了以下变更，以更好地应对和减轻未来洪水事件的影响：

1、用混凝土砌块代替干墙重建易受洪水侵袭的建筑物，以最大限度地减少基础设施损坏，并加快清理过程，以便快速恢复运营；

2、拆除易受洪水侵袭的办公楼内的所有地毯，以进一步促进清洁过程，并减少建筑物遭受霉菌或水损害的可能性；

3、对T型机库进行了改造，使洪水期间水更容易流过，以及彻底检修跑道照明系统，用更能抵御洪水的旧技术替换更容易受到水损坏的 LED 灯。

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圣查尔斯县斯马特机场

未来的挑战：

全球气候变化对自然灾害的影响威胁着美国各地通用航空机场的运营韧性，因为天气相关事件的发生频率和严重程度持续上升。机场工作人员提到的主要担忧是未来可能出现的更大规模、更具破坏性的洪水。需要不断改进与洪水相关的韧性规划和实践，以更好地应对和缓解这一迫在眉睫的威胁。

期望的未来改进：

1、获取便携式货物集装箱，并建立流程来管理和整理在发生洪水时必须从机场运走的设备和物品；

2、为飞机和其他设备创建一个整体的、统一的疏散流程，而不是目前的零碎流程；

3、在机场坡道和滑行道周围的跑道上举办半程马拉松比赛；4、开展无人机培训；

5、以遥控模型赛车为特色，建造一个研发设施；6、建立太阳能发电场。

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圣查尔斯县斯马特机场

调查结果摘要：

圣查尔斯县斯马特机场遭受的主要冲击是洪水以及洪水对基础设施和飞机造成的破坏。

1、改造T型机库以让水流过、重新安装非LED跑道灯系统以及更换建筑材料等恢复策略成功减少了财产损失，并使圣查尔斯县斯马特机场在洪水事件后更好地保持运营能力。

2、机场工作人员认为需要建立更健全、更精简的事故前规划流程，以便工作人员和租户更好地应对未来的事故和相关的潜在新障碍。

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各工具详细介绍-工具F-N

F-N模板与指南

工具F 应急通信计划模板
工具G 机场应急预案模板
工具H 事件缓解计划模板
工具I 利益相关者参与检查表模板
工具J 事件指挥系统模板
工具K 通信与协作指南
工具L 飞机救援与消防协议书

Tool F Emergency Communications Plan Template
Tool G Airport Emergency Plan Template
Tool H Incident Mitigation Plan Template
Tool I Stakeholder Engagement Checklist Template
Tool J Incident Command System Template
Tool K Communication and Collaboration Guidelines
Tool L Aircraft Rescue and Firefighting Letter of Agreement Template
Tool M Airport Resiliency Stress-Test Exercise-in-a-Box
Tool N Incident After-Action and Corrective-Actions Template

Airport Management

Airport management should be notified of an incident/event to ensure a unified and timely response.

Key Personnel Title/Name/Responsibility/Contact Information

Title	Name	Responsibility	Contact Information

Government Officials, First Responders, Regulators, Utility Providers

Local state emergency management, Homeland Security, state and local police and fire departments, regulators, and utility providers should be notified of an incident or event to ensure all possible resources are used during response efforts.

Key Personnel Title/Name/Responsibility/Contact Information

Title	Name	Responsibility	Contact Information

Tenants

Tenants should be notified of an incident or event to ensure their immediate safety and make sure they are aware of the potential for extended delays or disruptions.

Key Personnel Title/Name/Responsibility/Contact Information

Title	Name	Responsibility	Contact Information

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中国通航可复制的三步走策略

1、以省为单位成立“通航韧性联盟”，共享气象、燃料库存与救援资源，降低单机场采购成本，提升协同能力。

2、把韧性指标纳入通用机场取证年审，强制提交风险热力图与缓解投资计划，倒逼机场提前改造，确保安全运营。

3、依托民航发展基金设立“韧性专项”，对安装移动泵站、备用电源、应急通信的机场给予补贴，三年内实现高洪泛区机场全覆盖，形成可快速恢复的空地一体应急网络。

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通用机场韧性规划：构建自驱动恢复力

--Creating Self-Directed Resiliency Plans for General Aviation Airports

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通用机场运营、规划与管理

2025年10月21日

张彭康