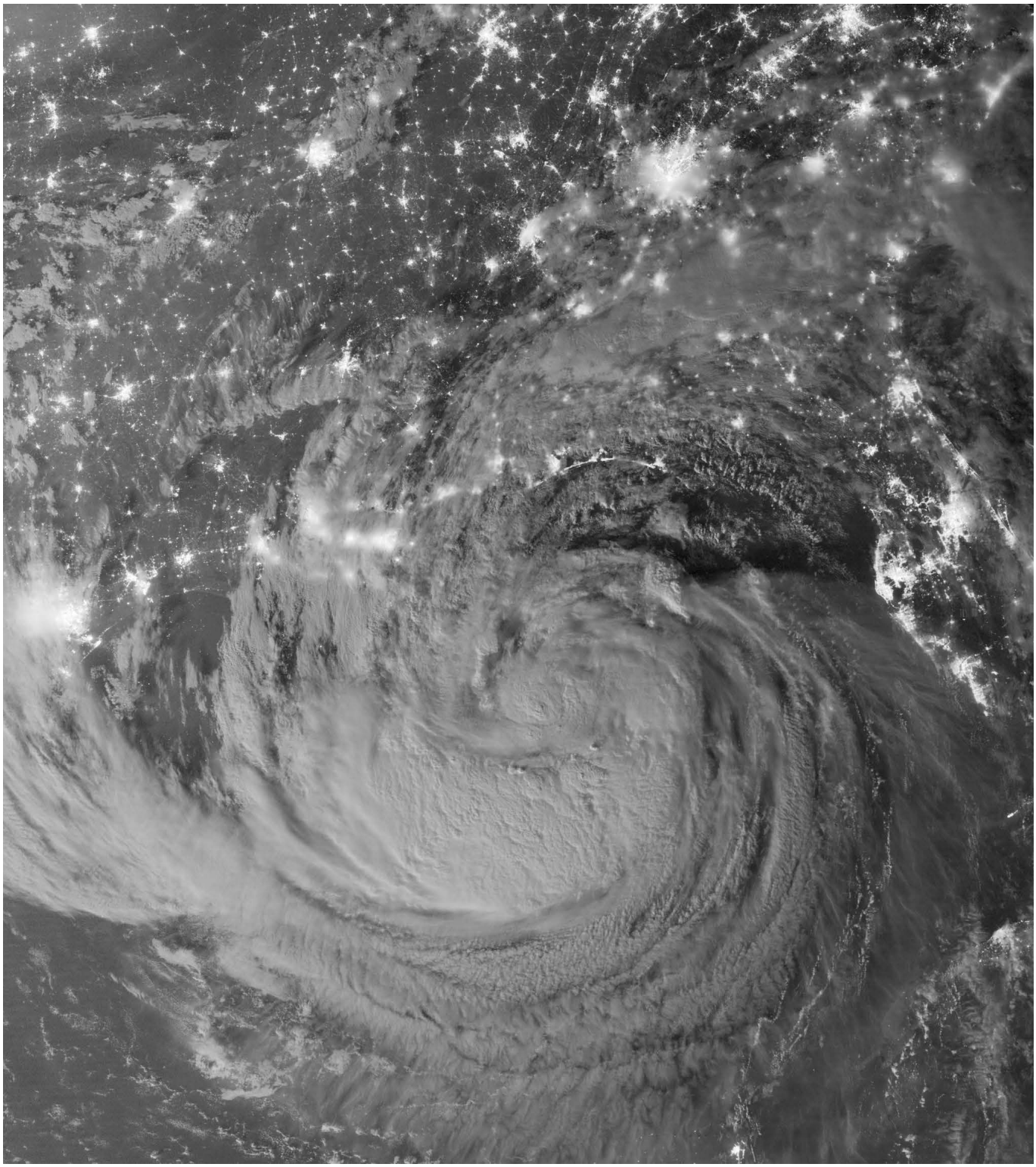
SUMMARY REPORT

EARTH EX® III 2019

Lessons learned from a global resilience exercise



EARTHEX THE RESILIENCE SHIFT EIS COUNCIL

AUTHORS

Avi Schnurr, John Heltzel, of Electric Infrastructure Security Council

CITATION REFERENCE

Heltzel, J., Schnurr, A. (November 2019) EARTH EX III 2019 – Lessons learned from a global resilience exercise. Summary report. Electric Infrastructure Security Council and Resilience Shift, UK.

Cover image: Tropical Storm Isaac by Night (Credit: NASA Earth Observatory)

CC BY-NC-ND 4.0

This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

ABOUT THE RESILIENCE SHIFT

The Resilience Shift exists to inspire and empower a global community to make the world safer through resilient infrastructure. More people than ever depend on the critical infrastructure systems that provide essential energy, water, transport and communications services, and underpin food, healthcare and education. When this infrastructure fails the consequences can be catastrophic.

Supported by Lloyd's Register Foundation and Arup, the Resilience Shift provides knowledge and tools for those responsible for planning, financing, designing, delivering, operating and maintaining critical infrastructure systems. Our aim is to ensure infrastructure systems are able to withstand, adapt to, and recover quickly from anticipated or unexpected shocks and stresses - now and in the future.

ABOUT THE ELECTRIC INFRASTRUCTURE SECURITY (EIS) COUNCIL

EIS Council hosts national and international resilience planning, training and research for complex, large scale catastrophe scenarios. As the founder of a unique, multi-sector systems engineering-framed resilience planning process and the all-sector, all-nation EARTH EX® exercise series, the Council also works with private and public sector leaders to develop critical tools needed to address such catastrophes.

DEFINING RESILIENCE

Resilience is the ability to withstand, adapt to changing conditions, and recover positively from shocks and stresses. Resilient infrastructure will therefore be able to continue to provide essential services, due to its ability to withstand, adapt and recover positively from whatever shocks and stresses it may face now and in the future.

Foreword

Our infrastructure is interconnected and interdependent. A major incident in one location can cascade rapidly and have an impact on critical infrastructure systems elsewhere, affecting their ability to function, to connect communities, provide essential services, or to protect society.

A 'black sky hazard' is defined by the Electric Infrastructure Security Council (EIS Council) as "a catastrophic event that severely disrupts the normal functioning of our critical infrastructures in multiple regions for long durations". How well prepared are we for such an event? The impacts of a major loss of electricity supply would rapidly expand into water, communications, food supply, finance, and beyond. A simulated catastrophic scenario can be a powerful way to raise awareness and strengthen individual, organisational and societal resilience to be better prepared for such an event.

Following the success of the EARTH EX exercises held in London and Glasgow in 2019, the Resilience Shift is pleased to continue its partnership with the pioneers at the EIS Council by supporting its unique all-nation, all-sector online resilience exercise.

A key element of our suite of activities dedicated to sharing learning across sectors, EARTH EX is a cross-sector tool promoting whole systems thinking, building knowledge of how to prepare for disruptions to energy supply and consequently increasing the resilience of all sectors to a black sky event.

We are delighted to have supported this year's exercise and to share its findings through this report.

The Resilience Shift team

Contents

Foreword 4
Contents 5

Executive summary 6

The origins of the exercise 9

EARTH EX 2019 design 10

Resilience lessons learned 12

Operational lessons learned 18

Marketing and advertising 21

EARTH EX III/19 geographic scope 22

Appendix 1 24

Executive summary

Purpose of the EARTH EX global resilience exercise

Building from two years of experience, with the advice, active support and financial backing of the Resilience Shift, Electric Infrastructure Security (EIS) Council designed EARTH EX III to create an all-sector, all-nation resilience exercise opportunity that could bring together individuals, families, corporate and government teams and executives in all sectors and many nations to participate in a planet-scale vision for a resilient, healthy and secure global society.

This report summarises lessons learned from this unique exercise, along with an early look at recommended next steps, and concepts for EARTH EX IV, in 2020.

Earth Ex III in numbers

>11,000
People

~2,000
Organisations and government agencies

38
Sectors

42
Nations

Summary

Based on unprecedented participation and on the remarkably consistent reaction of participants, EARTH EX III was an unparalleled accomplishment, highly praised by all players. More than 11,000 people spanning nearly 2000 organisations and government agencies, 38 sectors, communities and families participated from 43 nations, on every continent and nearly every major land mass, worldwide. Even today, after the end of the formal offering, organisations and individuals continue to register to participate, and requests for additional support continue to come in.

The exercise was an historic success.

All feedback, with (remarkably) no exceptions, was extremely positive, building excellent momentum for future exercises. Bringing critical resilience needs to life using a video-rich inject format with state-of-the-art production values, while meeting a range of training and awareness needs, EARTH EX is also extending the dialogue into areas underserved by current preparedness and resilience initiatives.

Our initial analysis found common trends across all exercise responses and surveys.

> *"EARTH EX has potential, if it continues to grow, to become a civilisation-scale event.*
>
> **- Anonymous participant**

Planning and plan integration

The need for the planning process hosted by EARTH EX became clear from all responses, with the need particularly acute in many areas.

Cross-sector coordination with tools and techniques

Availability of basic capabilities, techniques or tools for cross-sector communication and coordination among participating organisations remains minimal.

Resilience lessons learned

(see more detail in chapter 3)

Communications capabilities

The need for effective means of communication for emergency scenarios became clear from all responses, as one of the most important resilience gaps faced by organisations in all sectors, and all locations.

Resource management

Resource management is one of the most critical requirements in responding to disasters, on any scale. Feedback from exercise participants made it clear that, while this need was widely recognized, some of the most effective, proven techniques are not widely implemented.

Workforce preparation

Organisational planning for employee and family security in a disaster, highlighted in the exercise, resonated well across all sectors. While planning exists in many cases, communication, exercising and training in this area are common shortfalls.

Coordination

In our complex, modern just-in-time world, production of goods and services by organisations in any sector is only viable when they are successfully interconnected with an unprecedented variety of multi-sector partners and suppliers, and resilience within this brittle reality is only possible through excellent cross-sector coordination.

Other insights

ADVANCED COLLABORATION

Participants found the exercise a unique and valuable opportunity to bring teams, organisational sub-groups, and multi-echelon organisations together to discuss real plans and real response requirements.

PRACTICE AND REHEARSAL

Wide feedback from survey responses called EARTH EX III/19 a powerful tool to conduct executive and operational sessions, allowing leaders and their teams to review their processes and procedures, and educate their organisation on issues and shortfalls as well as strengths and weaknesses. All the feedback made it clear the exercise players were engaged and motivated throughout all phases.

EXERCISE DESIGN

The use of realistic video injects with high production values and the addition of advanced gaming elements supporting the decision-tree approach were exceptionally well received.

THOUGHT-PROVOKING

This term was used by many to explain that their involvement in all phases of the exercise enabled them to extend their level of discussion and decision making into areas not previously explored.

REALISM

The research and design effort, designed to bring severe hazards into focus in terms of real-world impacts was important to participants. That sense of realism, coupled with the call for practical solutions, decisions and action to move forward, drove participation, and gave all involved a solid sense of accomplishment, validating the exercise's unique design and delivery.

In the eyes of the players, the combination of the quality of the information provided, and the way it was delivered, made EARTH EX much more than just another exercise

EARTH EX engages participants to move resilience concepts forward because it feels real.

NEW IDEAS

The exercise offered a safe environment to train both new and seasoned participants, while providing an opportunity to talk through new ideas and potential solutions that may not exist today. The introduction of new concepts and technologies (BSX[1] and GINOM[2]) and new collaboration opportunities was recognized as important.

RETURNING PLAYERS

'Returning customers' represents an important metric for the success of any public offering. This exercise, the third and most advanced in the EARTH EX series, brought many players back from previous iterations, players who were motivated because they see value in moving toward a better prepared, more resilient future.

> *"We're looking forward to participating next year.*

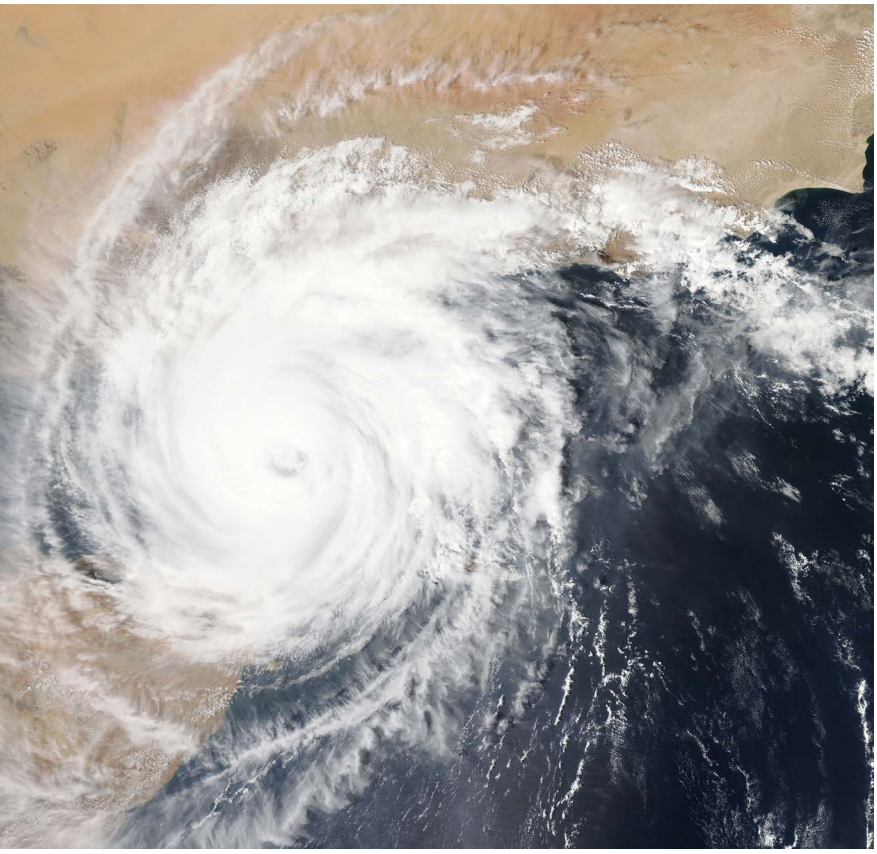
- One of the most common comments from participants.

(1) BSX is a notional advanced interoperable emergency communications system used in the EARTH EX exercise
(2) GINOM is a machine-assisted decision-support simulation used in the EARTH EX exercise

01

The origins of the exercise

The vision for this unique exercise emerged from the growing realisation that, in our modern interconnected world, coordinated resilience to extreme hazards must ultimately grow to span all nations, all sectors, and compassionate, concerned people everywhere. An unprecedented exercise tool was needed that could go far beyond any past attempt to build awareness of the need, while providing guidance to best practices in all sectors, everywhere.



Extreme weather

Rare typhoon in the Gulf of Aden (Image by NASA)

EARTH EX was born to meet this need, and the result surpassed all expectations.

EIS Council developed the first exercise in the series in 2017, with the participation of dedicated and visionary leaders in a handful of partner companies and agencies. The one attribute they all shared was a growing awareness of the fragility of the world's interdependent infrastructures, and an unflagging personal dedication to the potential of the human spirit, in all its many guises, colors, locations, and tongues.

From this beginning, by three months, participation spanned ten states and 40 companies and government agencies. By five months, 180 organisations, and three nations. By the launch of the exercise at six months, it had grown to 500 corporations and agencies in nine nations with participants spanning 16 infrastructure sectors. The U.S. Department of Energy added EARTH EX to the National Exercise Program, with an Executive Tabletop exercise taking place for federal agencies in FEMA's National Recovery Coordination Center.

Today, with participants on every continent and major land mass, EARTH EX is bringing together the world.

02

EARTH EX 2019 design

The EARTH EX series integrates state-of-the-art video and exercise tools, building on, and beyond, proven processes to strengthen resilience on individual, family, organisational and societal scales, training individuals and organisations in several dimensions of disaster preparation and response. Situational awareness, assessing organisational impacts and capabilities, developing courses of action, and making decisions all represent critical and highly leveraging processes that can benefit from this training.

To accomplish this, the exercise builds a sense of excitement by focusing each year on different hazard scenarios which are also tailored to exercise – as the series continues – all aspects of disaster preparation. And given the new and expanding risks associated with global-scale interdependencies, these scenarios focus on the class of extreme, complex catastrophes (black sky[3] events) that would result from serious disruption of today's globally interconnected infrastructure sectors and supply chains.

The EARTH EX III/19 design focused on helping people understand the need and opportunities for a well-developed, readily executable disaster response plan, against the background of the surge of recent disaster scenarios.

From EARTH EX

The BSX EMERGENCY COORDINATOR, providing sector-by-sector updates on the progress of the disaster.

The exercise focuses on specific processes and tools needed to make timely decisions and communicate and coordinate resources, especially in enabling mutual aid and emergency assistance.

To do this, EARTH EX III/19 presented two distinct scenarios:

- A rising flood scenario that requires players to manage their on-going response efforts.
- A catastrophic near-black sky-level windstorm that follows, requiring each element of an organisation to work through distinct stages, and make decisions that are key to supporting restoration.

In phase three of the exercise, a video report uses the same, high-realism approach as the two impact scenarios to give participants a detailed blueprint summarising the interlocking, multi-sector capabilities needed to prepare and to restore communities, lifeline infrastructures and their partners in serious crises. The value of this approach, praised by participants, became clear from user reaction to an early version with a similar role, tried out in the 2018 exercise. As they emerge from the exercise environment, participants appreciated the comprehensive review of successful resilience strategies provided in this phase.

(3) Black sky events refer to extreme disasters, also termed "complex catastrophes," capable of seriously disrupting all infrastructures, utilities, product and service sectors on large regional or global scales.

From EARTH EX

'SKYCOM NEWS' weather anchor, providing some technical terminology to help participants understand the recent expanding weather disasters which formed the basis for this exercise

03

Resilience lessons learned

The **six resilience-focused lessons learned** provide a baseline for further optimisation of the exercise series. Each represents an assessment emerging from a compilation of exercise responses, survey responses, and direct feedback.

Planning and plan integration

The need for the planning process hosted by EARTH EX became clear from all responses, with the need particularly acute in many areas.

A common response, from many organisations, was that the conditions and scenarios presented – designed to help review an organisation's current planning posture – greatly exceeded their current level of planning. In some sectors, participants freely admitted that EARTH EX was a beginning point for their internal planning for response to any significant disaster. This response was sobering, since the degraded environment portrayed in the exercise was quite similar to recent worldwide climate-driven disasters.

While not universally cited, several organisations had made significant progress over the previous two-year run of the EARTH EX series. Others, new to the professional exercise world, readily stated that the exercise provided the impetus needed for them to coordinate actions and initiate needed planning efforts.

CONCLUSION

Overall, planning for black sky events, and even disasters of a much lower level, is insufficient to ensure restoration of critical lifeline infrastructures and essential services. Nearly universally, where plans do exist they are not coordinated across agencies and sectors. Highly complex, interdependent systems and supply chains today still function as disconnected "silos" with few opportunities to layer plans and manage resources to meet critical timelines.

This area needs to be reinforced in current training plans and integrated into future exercises.

FEEDBACK

> ***"Personally, I need to involve my family in creating emergency planning and put together a disaster supplies kit and a family reunification plan. For my sector, we must have emergency planning for long-duration power outages and well-defined procedures for reaching out for mutual assistance."***

- Individual and Family Lane participant

Cross-sector coordination with tools and techniques

Availability of basic capabilities, techniques or tools for cross-sector communication and coordination among participating organisations remains minimal.

EARTH EX portrayed a real-world event, with breaking news reporting interdependency-driven, cascading impacts. Participants received this information in various forms, including dynamic cross-sector injects and universal text prompts to ensure organisations gained a basic understanding of how the disaster scenario was affected by their partner sectors.

Such cross-sector impact data was clearly new to most organisations, and few were able to manage a sophisticated response – i.e., to adjust their internal response posture based on impacts to such partners or adjacent elements, even when those elements directly affected their own operational capability (such as the availability of critical water, fuel, communications, or other vital supplies or services).

Most organisations indicated that, while they were aware of the underlying issues, working through the exercise made them aware that their current planning has gaps in core areas. Few indicated that they had established the kind of relationships needed to address such interdependency issues in advance. Many cited the need to integrate operational requirements into the local emergency response plan, but few had reached that goal.

To achieve a higher level of resilience, most participating organisations will need to prioritise investment and planning to ensure they have critical operational resilience assets (such as backup power generation), and to initiate active coordination for essential service levels (communications, workforce).

CONCLUSION

Overall, responses identified a need for improved tools and techniques to share situational awareness and assessment techniques and the ability to communicate status information to local and regional entities to meet efficient response and restoration requirements. For the severe weather scenarios portrayed, it is not that efforts would fail completely, but that most organisations would struggle, and be less efficient than needed to meet even immediate needs. In some instances (Medical/Emergency Management Services), these inefficiencies could result in a loss of life.

Organisations spanning all sectors clearly require training to understand options for advanced tools and techniques that could enable them to share and receive status information from key partners.

In our future exercise work, reinforcing these areas will be key to help participating organisations develop, implement and share solutions for effective coordination with key partners.

FEEDBACK

> ***“It was very eye-opening and thought-provoking. Resilience is not built into the local systems at all. Great framework with realistic scenarios that forces organisations to stretch their thinking and really evaluate their resilience and preparedness.***

- Community Leader Lane participant

Communications capabilities

The need for effective means of communication for emergency scenarios became clear from all responses, as one of the most important resilience gaps faced by organisations in all sectors, and all locations.

Throughout the exercise, the evolving scenario was framed by the fundamental need for interoperable communications to deal with a disaster. In response, many participants noted the need for expanded investment in emergency communications, and the need to integrate planning to identify key, common communications nodes and networks (such as interoperable emergency comms).

Few organisations indicated they possessed more than one or two forms of communications. Only emergency services, along with a few from the medical lanes, indicated they had a reliable form of radio communications. Very few, disturbingly, indicated that they had a communications capability with a backup power system that would work in the EARTH EX III/19 scenarios.

CONCLUSION

Nearly all aspects of response – both to the exercise scenario and, correspondingly, to any significant disaster – depend fundamentally on effective, interoperable emergency communications. Participants realised that, without such tools, each facility becomes an isolated island – that the entire restoration mission depends on communications.

In fact, since it is impossible to even portray an effective restoration scenario without such capabilities, the exercise was framed by a notional, advanced interoperable emergency communication system (BSX)[4]. Poignantly, several organisations asked how they could get access to that notional system.

As perhaps the most critical aspect of resilience planning and investment for significant disasters, it is crucial that organisations prioritise investment in resilient communications tools and plans. The exercise feedback made it clear that this aspect must remain an integral part of future exercises.

FEEDBACK

> *Excellent exercise! It helps us to prepare for potential disasters and to know what we're not yet prepared for.*
>
> *It was very realistic with the newscaster, loss of connection, footage, etc.*
>
> *Earth Ex 2019 is the best emergency preparedness training I have done. Realistic, factual, and well done.*

- Participants

(4) While advanced, black sky-capable systems like BSX are not yet widely available, simpler, conventional systems are easily available, and would be enormously helpful in moderate disaster scenarios.
For BSX, though wide distribution is notional at this time, EIS Council is partnering with a leading US power company, in coordination with the Federal Communications Commission, and early deployment testing of this advanced black sky-capable system is underway. For more information, write to info@eiscouncil.org.

Workforce preparation

Organisational planning for employee and family security in a disaster, highlighted in the exercise, resonated well across all sectors. While planning exists in many cases, communication, exercising and training in this area are common shortfalls.

The exercise's emphasis on regional impact and response encouraged participating teams to take a close look at consequences for people and families – at both the organisational and community levels. Thus, a primary theme was the importance of paying close attention to the human side of disaster. Restoration can only take place if the full, required team is secure and available, making advance planning for both employee and family security crucial, along with frequent updates for the full team.

In working through the exercise, organisations identified the need for a standing procedure to communicate directly with both key employees and the broader workforce on safety and security. Given the diverse sectors, regions and organisational roles, there is no 'one size fits all' approach, but participants recognized the need to develop standard procedures and techniques for use in a variety of disasters. At a minimum, this includes finding workable solutions – for different classes of disaster – for sheltering, sustaining and updating employees and their families.

Many organisations indicated they had formal procedures written to address these requirements, but had no plans to practice or train to those procedures, or to implement them if traditional communication systems failed.

CONCLUSIONS

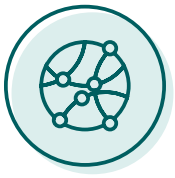
Organisations frequently include some level of planning to secure and sustain their workforce in disasters. However, few have any mechanism to implement such plans without cell-phone (mobile) connectivity. Fewer still have any process to practice or train to their plans, and countless studies have shown that planning alone, without training, has little value.

Guidance to help organisations build – and train for – solid plans to secure, shelter and sustain their employees and families, with or without cellular (mobile device) communications, will be an important goal for future exercise development.

FEEDBACK

> ***It helped me focus in on what steps our organisation should take to be better prepared for an event.***
>
> ***Made us think, really think.***
>
> ***Allows anyone/everyone to find weakness in their plans, whether individual or multiple areas.***
>
> ***This provided an opportunity to sit with the manager, supervisor, and operator level employees and discuss our concerns and needs for our system in an event of this magnitude.***

- Participants



Coordination

In our complex, modern just-in-time world, production of goods and services by organisations in any sector is only viable when they are successfully interconnected with an unprecedented variety of multi-sector partners and suppliers, and resilience within this brittle reality is only possible through excellent cross-sector coordination.

Based on the responses to EARTH EX III, unfortunately, most organisations' resilience planning occurs in a silo. Coordination with suppliers and partner sectors is rare.

In today's interdependent reality, expectations for even basic resilience without careful coordination, both before and during a crisis, are unrealistic. In fact, to be effective, communication and coordination must extend from the organisation to the individual to the lifeline infrastructures and community asset base, and from the community to the senior, responsible government agency.

For extreme hazards, this may be important even across national boundaries.

Of course, even with the best coordination, in the chaotic conditions that would accompany extreme black sky scenarios, a decision maker's situational awareness will be incomplete. Leaders will need to make assumptions and take action in advance of confirmation, making decisions that will become far more effective once machine-assisted decision support simulation becomes available[5].

Yet, while planning, implementing, training and exercising such capabilities in advance is essential for meaningful expectations of resilience, achieving this is difficult and, unfortunately, rare.

From the feedback, few organisations have plans that will allow them to coordinate in a disaster with their partners or suppliers. Even within an organisation, shortfalls were commonly identified in coordinating vertically among different functions.

CONCLUSIONS

Participating communities and organisations made it clear that EARTH EX gave their teams a vital head start, encouraging and pointing the way ahead for key internal and external coordination planning. This should continue to be a key element of future EARTH EX exercises.

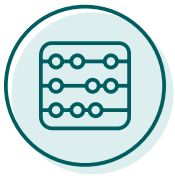
In fact, this area would also benefit from additional, organisation-focused analysis and planning. As just one example, without GINOM, detailed response and restoration coordination guidelines (or 'synchronisation matrices') could help with both coordinated planning and setting reasonable expectations when direct communications are impossible or fractured. This could be an area where development of separate, focused, supplemental exercises could be highly leveraging.

FEEDBACK

> ***The exercise gives an accurate view of a long duration power disruption.***
>
> ***Very thought-provoking and informative exercise.***

- Participants

(5) As suggested by the GINOM tool in the exercise.



Resource management

Resource management is one of the most critical requirements in responding to disasters, on any scale. Feedback from exercise participants made it clear that, while this need was widely recognised, some of the most effective, proven techniques are not widely implemented.

In assessing lessons learned from a wide range of major disasters, analysts have found that, time after time, the quality of advance resource planning provides the most accurate forecast for the success of disaster response. As crises develop, a team's ability to improve the outcome of their mission turns on their ability to flow critical resources to meet their organisation's responsibilities to their public and private partners for the emergency.

Given this, by design, EARTH EX III/19 focused on resource management as a key operational requirement during the decision-making phase. 'Mutual aid' – advance planning by similar organisations to share resources with a partner hit by disaster – was highlighted as a best practice that has been remarkably successful, where implemented.

Given the nature of many severe hazards, building such relationships requires careful, advance development, training, and exercising. In exercise feedback, participants reported that, while they were familiar with mutual aid concepts, few had developed such partnerships in advance.

CONCLUSIONS

This is an area where organisations in many sectors could benefit, almost immediately, from following the best practice examples of more advanced partner sectors. At the same time, for some, the requisite resources and training are simply not available.

In both cases, EARTH EX provided a unique opportunity to review the need and opportunity, and advance the discussion and, where possible, build specific plans.

Where needed, future exercises may also be helpful to build a broad base of organisations that could encourage government agencies or other stakeholders to enable development of such practices.

FEEDBACK

> ***"It was very eye-opening and thought-provoking. Resilience is not built into the local systems at all. We must have a degree of self-sufficiency that is hard sell for people used to having every convenience at a whim.***
>
> ***Easily one of the best tabletop exercises I've seen---anywhere!***

- Participants

> ***"Además de solucionar el aspecto de las reservas de víveres y herramientas, es importante mantener conectadas todas las dependencias públicas para que cada una, desde su nivel de competencia realice las actividades necesarias para tratar de solucionar el problema. Entre todos será más fácil.***

Translation: "*In addition to having a sufficient stock of food and tools, it's important to keep all the public bodies connected so that each one in its competency level can perform the necessary activities needed to solve the problem. Collaboration between everyone will make it easier.*"

- Spanish participants

04

Operational lessons learned

In addition to enhancing the utility of the exercise for guiding resilience planning, analysis of participant involvement and responses is key to assess and improve exercise execution. The results of that analysis, for all aspects of exercise operation, are summarised below, followed by additional opportunities that may be considered for further execution improvement.

Operational lessons learned from participant feedback

EXERCISE APPLICATION: BATTLE RHYTHM MANAGER

Operational performance of the exercise support tool - 'Battle Rhythm Manager', which was further enhanced to support EARTH EX, was impressive. Seamlessly supporting customised delivery of multiple phases for 38 different exercise lanes across the globe using web-based technology, in a variety of formats and languages, its performance was simply unparalleled.

The application support and exercise development teams did an outstanding job.

EXTENDED TIMELINE

Based on feedback from previous exercises in the series, the timeline for EARTH EX III/19 was extended, running from 15 August through 31 October. Allowing participants to independently schedule the date for the exercise, the change proved highly effective, providing time for participation to grow as awareness of the opportunity spread, and effectively removing the scheduling constraint for those wishing to participate. Feedback was quite positive, and the enhancement was widely appreciated.

EXTENDED REGISTRATION

For EARTH EX III/19, the registration link became active in early January, well before the exercise was fully constructed. This change allowed organisations to self-identify, become part of the exercise design team, participate in advance training webinars, and gain insights into the exercise design. We will include this change in future exercises where possible.

VIDEO INJECTS

The use of carefully constructed video segments, or 'injects', was seen as a key feature of the exercise by nearly all participants. Designed to convey the evolving stages of the exercise scenario to the different sectors in a form that fully engages participants in

the event, the writing, production and acting team's attention to detail and high production values was both unique and highly effective. Viewers reported that the video injects were very realistic, keeping them engaged and adding to the overall excitement of the exercise environment.

EXERCISE LENGTH

The exercise was designed to provide organisations in any corporate, organisational or government sector, as well as families and communities, with an opportunity for in-depth learning and self-assessment. When played properly, that takes several hours. While this was widely appreciated, some organisations and participants felt an option for a shorter exercise would be helpful.

Scaling the exercise to allow for effective, shorter duration engagement is challenging for the complexity of an information-rich, globally-distributed, cross-sector exercise with distributed self-assessment and self-facilitation. Some approaches and variations in presentation and facilitation may increase flexibility in this area, and will be explored for future exercises in the series.

Additional operational enhancement options

The exercise leadership and support team, assessing the exercise in the light of experience with a wide range of other exercises, has developed additional options that may be considered to further enhance delivery of the exercise, broaden participation, and strengthen the proficiency of participants.

MONTHLY ANNOUNCEMENTS

Building on previous exercises, this year's unprecedented exercise has resulted in a solid, experienced base for future exercises. Sending out monthly electronic messages about the exercise and the lead-up webinars should now be feasible, and could help build awareness and training.

INTEGRATING ALL EXERCISE ELEMENTS INTO THE OPERATING TIMELINE

Beginning in 2020, monthly resilience and awareness webinars will be integrated into the overall exercise timeline, along with highlighted training opportunities.

EXPLORING WIDER INTERNATIONAL OUTREACH

Given the success the Resilience Shift demonstrated by sharing information with its host firm, Arup's international offices, it may be worthwhile to dedicate a focused effort to exploring opportunities for further international sharing of the exercise opportunity.

EXPANDED, CUSTOMIZED EXERCISE PLAY OPTIONS

A number of organisations told us this year, that they found ways to optimise engagement with the exercise, and provided valuable feedback on how different configurations could help them further enhance its use for their needs. It may be possible to explicitly build in support for such 'customisation options', providing for selectable configurations that can be optimised for participants ranging from individuals to multi-echelon organisations.

PRIVATE SECTOR EXPOSURE

As expanded marketing and advertising options are considered, adding a special effort focused on specific private sectors may be helpful, especially for those sectors most directly critical to societal resilience. This would, however, require developing targeted approaches for a given sector, since the issues addressed by different sectors are typically unique.

FOREIGN LANGUAGES

Analysis showed that participation in languages other than English was limited, in part, perhaps, because many professional teams in non-English speaking nations elected to participate in English. Adding internal staff support for Spanish or expanded Spanish language advertising may be needed to improve the utility and effectiveness of multi-language support.

ACADEMIC INSTITUTIONS

Participation by individuals and groups at universities and related academic institutions was excellent, and this area should be explored as an avenue for more extensive outreach. The exercise's timeline flexibility was crucial in this area.

ENHANCING SECTOR GUIDANCE BY FOCUSING ON FEWER 'LANES'

Based on assessment of this year's participation, focusing effort on greater detailed guidance – helping organisations go further in developing their internal planning – may be valuable for participants in all sectors. Putting more development effort into this area in future exercises, rather than continuing to provide the wide spectrum of lanes supported this year, would likely be an excellent tradeoff: respondents' input did not support the need for this year's wide array of lane offerings, most of which featured very small variations.

This shift in focus will require minimal operational changes, with no net impact on the support team to adjust the exercise offerings and provide the required materials.

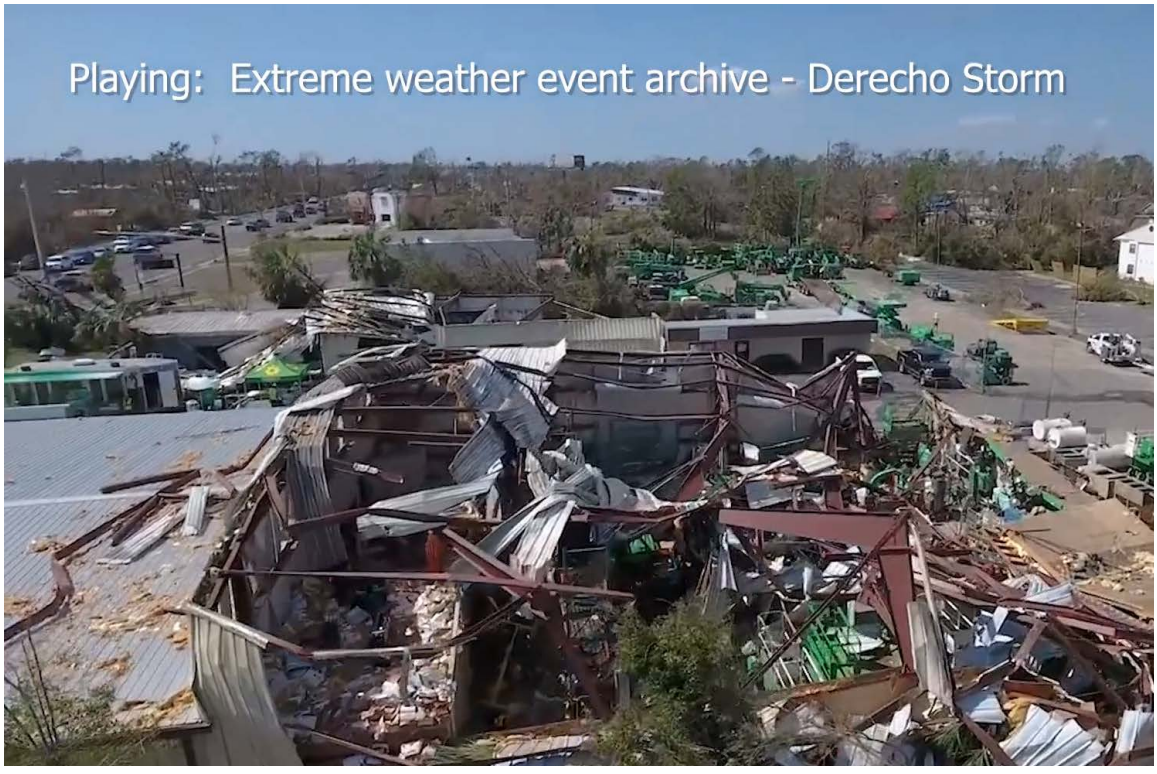


Image from the EARTH EX III scenarios. Participants were presented past extreme weather events and the damage these events could cause

05

Marketing and advertising

With many thousands of organisations, government agencies, communities and families participating from 40 nations, EARTH EX III/19 became the largest resilience exercise in history.

Given our world's fast-growing interdependency and the inexorable globalisation of all resources, services and supply chains, this represents what could become a remarkable and vital opportunity. With the highly effective assistance, engagement and support of the Resilience Shift, the exercise founded a new dimension in coordinated crisis planning that spanned all sectors, available to interested participants in any nation.

Promotion support focused primarily on sharing via social media, content dissemination on the Resilience Shift and its host firm Arup's channels and platforms, and some limited outreach to external media.

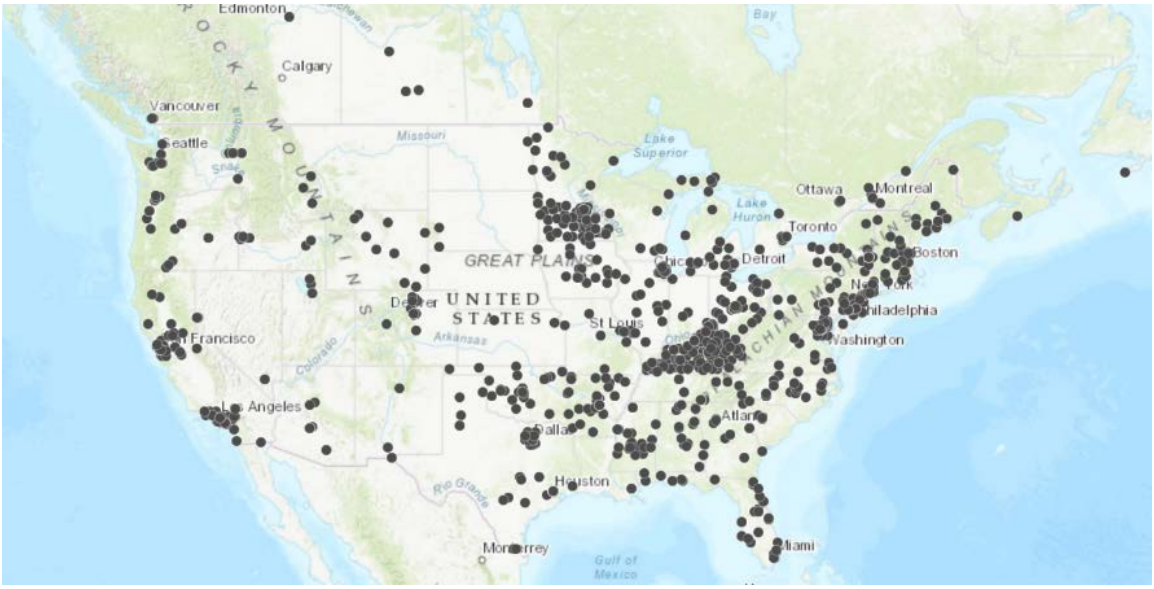
In evaluating the growth in participation, word-of-mouth sharing was the most important single factor. This suggests that, if marketing and advertising, in particular PR, are made the focus of a separate operational effort, future exercises could see substantial, additional growth – approaching, perhaps, the vision of 'civilisation-scale'.

> *"EARTH EX has potential, if it continues to grow, to become a 'civilization-scale' event.*
>
> **- EARTH EX participant**

06

EARTH EX III/19 geographic scope

The scale and worldwide range of participation in this exercise exceeded all previous records. The maps, provide a top-level snapshot of participating organisations' locations, based on registrations.



North American participation locations

PARTICIPATION BY NATION

United States	Hong Kong	Bangladesh	Puerto Rico
England	New Zealand	Belgium	St Pierre and Miquelon
Scotland	Singapore	Bolivia	Saudi Arabia
Ireland	Italy	Colombia	Slovenia
Canada	Mexico	France	Turkey
Australia	Romania	Germany	United States Islands
South Africa	Spain	Hungary	Vietnam
Ireland	United Arab Emirates	Indonesia	Brazil
Israel	Bulgaria	Malaysia	Japan
India	China	Netherlands	
Norway	Virgin Islands, U.S.	Philippines	

Worldwide participation locations

Appendix 1

Responses to the Resilience Shift survey question:

As a result of taking part in this exercise, will you be changing the way your organisation plans for resilience to shocks and stresses? Yes/No
(if yes, please provide some details).

For analysis and archival purposes, responses to the post-exercise survey suggested by the Resilience Shift team are provided below.

- Yes, we need to review plans for options beyond 72 hours.
- We will be evaluating local assets and supplies.
- We will be updating our response plan for long-duration disasters.
- Long term power outage planning.
- I will continue to stress the importance of training and educating staff and management on key factors.
- I will re-evaluate our resilience plans immediately.
- Evaluate our MOU's for priority response.
- Work with the local hospital to develop a plan.
- We are going to totally rethink our EOP.
- Continuity planning.
- We are already in the formation of new ops and procedures related to cybersecurity, but this is helpful.
- We will review our Continuity of Operations Plan.
- Incorporate findings into ERP (note: for water systems serving more than 3300 people, updates from participating should be mandatory).
- We will be running the exercise again with wider participation, but I think it is clear (if not glaring) that we have a tremendous amount of work to do. I set our current Mitigation Plan open on an extended monitor and searched specific issues as the exercise unfolded. I found great gaps in core capabilities that we will address, one of which is our wastewater resiliency. It looks to me like that is the first critical lifeline to completely fail in an LDPO scenario and over 70% of our population ties into a single plant (over 200,000 people). That's just one of many serious issues we face. Thanks to EIS and their partners for creating such a high-quality platform to help us recognize our shortcomings and begin the process of rectifying them.
- We are going to focus on our Interoperable Emergency Communications and situational awareness.
- Explore what we need to do to be more prepared for a power outage.
- I plan to review our BC/DR Plan for our Facilities.
- Our facility uses past experiences and these exercises to better our responses and preparedness -- staff accommodations, communications with local emergency services, power outage responses
- More training and information gathering, planning
- We will likely improve some of our processes.
- We will establish a closer relationship with our EMS provider and Electric Company.
- We will increase our planning efforts for recovery and resiliency.
- Have better planning and preparation for such an event.
- Looking at what supplies we can keep on hand. Try to get more interconnected with customer city emergency communication and planning. Bring the idea of participating in a regional event with all customer cities and TRA facilities to upper management.
- I will ask the board to make a detailed disaster plan and to designate key persons both nearby for immediate action and throughout the city as contact points. I will make a plan for my family that will include the basic minimum things we will need to take care of at the facility and be prepared to take friends on short notice if possible.

- We will find more ways to be prepared and identify who we need to communicate with before a situation happens
- Drive further cross-company coordination in a very large company.
- We have advanced COOP planning revisions planned.
- We will develop an Advanced COO approach, including the relocation of headquarters operations well beyond the region we work in and enhance the use of the organisation's emergency alerting system.
- We are not well prepared and will be rewriting our emergency plan.
- We're going to look at vendor agreements, transportation (cleared byways and alternative transportation [boats/helicopters], and how to better provide for our employees and their families to make the restoration process better and less stressful. Also, we need to manage public expectations for an emergency of this magnitude.
- We need to work more with employees to understand the importance of our roles.
- We will take what we learned from our exercise discussions to fill the gaps found in our ERP.
- Increase awareness.
- It is smart to start thinking about events that are out of our normal routine.
- We need to focus on planning for employee families for these situations.
- More preparedness is needed by administration/management.
- More needs to be done in the planning area, and I will provide feedback to our Exec Management and Emergency Manager of this topic.
- We will be implementing more training, running our emergency reports more frequently.
- Reach out to mental health agencies.
- This exercise helps us know what materials we do and do not have and helps us feel and know that we are prepared.
- Evaluate plans for accessing critical information, situational awareness, and effective communications in the event of a black sky event.
- We will make a better effort to ensure we know who the players are during an event and see what everyone can do to help. We also need to look at our continuity of operations plan.
- The best resilience for shocks and stresses is to continue ongoing training of personnel at all levels, participate in community-wide disaster drills to test our facility and staff's capabilities in a disaster situation.
- Processes for accessing additional staff and resources from our agency are still not well defined. We need to improve this area.
- Better briefing and support for line staff.
- Preplanning is the key, and it all begins at the top level. Promote the top level down.
- The main result is the push for us to plan better and be prepared.
- We are going to work for better coordination procedures with the Hospital and School District.
- Not sure what will be approved by management. Will propose drills and formal process.
- The US Dept. of Homeland Security/ The Calif Medical Reserve Corps and DHV / and the large watershed where I serve, will be stronger by my EARTH EX training over the years.
- My area will be doing some work on employee preparedness training.
- We are going to review and update our emergency response plans and planning for black sky events.
- Further, clarify employee preparedness on personal levels.
- We will be looking at our ability to communicate inside and outside of the facility.
- Continuous reassessment, training, benchmarking versus the best practices to assure an optimal outcome.
- We will be conducting more planning, and we are always looking at new options and suggestions.
- We'll be researching alternate communication methods as well as building relationships with local companies to explore mutual support options.
- We will improve our communications options.
- We captured various items for follow-up.
- We will consider if we need to prep for a longer period.
- This exercise was about flooding. We experience flooding every year due to Hurricanes. But this exercise did help us to remember what we did right and what we still need to accomplish.
- We need some improvement to our EOP.
- Contingency plans for supply chains.
- Discuss ways to adapt to different levels of destruction and the ability or inability to receive assistance.
- We realised the importance of having drills for staff.
- We are developing multiple contingency plans for supply sources.
- Looking into long term mitigation planning and updating (increasing) MOUs with outside support agencies.
- Yes - we need to hold onto that mindset of being prepared.
- Better MOU's.
- We will continue to develop our black sky planning with our partners, and the exercise highlighted the need for emergency communication methods and/or standing orders to gather to share or develop situational awareness during an active black sky event.
- We are developing many ideas for how to be prepared and hopefully enacted.
- Will add some additional items to our preparedness kit. e.g., blankets, solar phone chargers, and toilet paper.

- We are creating a more robust supply chain management plan.
- Better pre-planning.
- We are looking for ways to improve communications and resource management.
- Look into more back up suppliers.
- Start stocking up and build an emergency supply for if disaster strikes.
- Get a generator, emergency food supplies, portable batteries.
- We need to reassess the way we look at emergencies and prepare for shortages that may occur from a long duration event like this. Manpower and our reliance on other partners and agencies (who may also be stressed and/or destroyed), we need to assume when we are planning that 'what if' they are not there, what are our other options.
- Our team has dealt with floods many times before, and almost all feel confident in their ability to plan and handle the stress of flooding.
- Our team has dealt with floods many times before, and almost all feel confident in their ability to plan and handle the stress of flooding.
- We will continue to join this exercise and makes us realise there are other ways to get planning ideas.
- Supply chain triage, EEI, stacked volunteers for communications.
- We identified gaps/needs in our existing plans and will be modifying them as necessary.
- I will be discussing this with our Community Emergency Response Team coordinator.
- This exercise highlighted the need for my organisation to develop a much more robust flood mitigation/response plan.
- More supplies and tarps
- However, we still have a way to go.
- We need to plan for longer-term events with more granularity around resource capabilities.
- We have identified seven areas of improvement and three lessons to guide changes in our DR/BC Plan.
- We have some additional steps and vendors that we need to contact to determine their DR plans. Our critical mission is providing cash to the community as long as we have it, and our supply isn't stopped.
- Better prepared.
- I will share my thoughts on this exercise, and the exercise itself within my community, and I will start a conversation about what plans we have and what can be done to improve them.
- Focusing on community partners' involvement, we can't do everything ourselves!
- We are looking at addressing these hazards with our regulated utilities and with our emergency preparedness partners.
- Some issues/concerns need to be brought to TVAP&EM managers to discuss.
- Conduct more in-house education. Reach out to local HCC members for support.
- We need to extend our emergency power capacity beyond three days.
- We will prioritise MOUs with private partners.
- Try to have been communication and practice drills.
- More details and information.
- We will make a call tree and hopefully partner with other companies in a mesh fashion to protect against disasters that happen within say a 20-mile radius.
- Identify gaps in existing plans with the intent to resolve or mitigate them
- Just making sure everything is in place,
- Individually I need to spend some time looking into HAM radio. I also need to get a reunite plan together with my family.
- We are looking into the organisation's policies.
- I am not sure if they are changes, but definitely, some things came up that maybe we hadn't fully prepared for or discussed. For example, different organisations or partners that we need to meet with to set up contracts or MOUs with for porta-potties, sandbags, water, etc. Also, we need to figure out ways to communicate with staff and partners when the internet, phones, media, etc. are out.
- I may stress the fact that as members of this team, you may be put into a position where you are away from your family for some time.
- Taking our 3-day plan and determining what we need to do to turn the plan into a 7-day plan.
- We will be considering who in Transmission Planning would likely be called upon to respond to an emergency and review our overall readiness.
- We need to place more emphasis on educating employees on how to receive emergency information while not at work.
- Teams that thought they were critical and required for Mass Care learned they are not critical and can close for days.
- Extended loss of power to our primary facility would be a very serious situation as alternate sites are in extremely short supply. We do not have a generator nor the connecting/control equipment for one. The first step will be to work on getting that connection equipment and then identify sources in the region with large enough generators we could rent and use and get them under contract.
- I am interested in seeing us do dry runs. I spoke to our Executive Deputy Director about it, and she was supportive.
- This effort is more about how to think about these events. We should probably have a weather radio, flashlight, and other small emergency equipment.
- More preplanning.
- Contingency will always be planned for long-term loss of power when possible.
- We know where to focus our efforts, depending on the stage of the disaster.

- Perhaps we predetermine who is the essential staff and who is not so that during emergencies, the non-essential people know they are not needed in the office and can stay home. This effort will minimise the need for communication as who should try to report to work if conditions permit.
- More consultation with participants and groups. Who can bring what to the table and work together to achieve and overcome the situation?
- Our organisation is going to add additional practice sessions, training, and rethinking our processes.
- Increase scenario training, look at ways to improve equipment caches and further education.
- I will make sure that we have back power, food, and water. Also, have backup communication avenues.
- We are adding more supplies and battery backups for amateur radio gear.
- Additional exercises and training.
- I need to find a second location for personal papers and documents and a sack of some kind of monetary backup.
- We can be more resilient by having additional sources of materials and additional supplies.
- I will do whatever I can to help with making everyone aware and better prepared for what is coming.
- We are adding additional preparedness functions, including the COOP and communication plan.
- Develop the ability to re-locate and be mobile.
- We are developing a 7-day emergency preparedness plan to ensure we have enough resources and supplies to care for our staff and patient population.
- Where appropriate, to bring up my concerns based upon what I learned in the exercise.
- We will be completing more internal exercises to prepare.
- I will advocate for greater internal preparation, awareness of emergency ops plans, and response exercises among staff.
- Encouraging staff to be better prepared personally, so they don't have to worry as much about their own families while responding to an emergency. Creating more lines of communication with other agencies to assist with planning information for flooding events.
- Utilise our sewer model, currently under development, to entertain "what if" scenarios to determine priorities in our collection, conveyance, and treatment facilities.
- Provide more information to our staff about what can happen in these situations.
- I am focusing on getting my division ready for any future incidents.
- We are updating our emergency operation planning and more collaboration with other agencies.
- We will be planning for a more long-term sheltering/evacuation scenario.
- We need to review all our back up power capabilities.
- Getting MOU's, Employee Education, Community Involvement.
- Future staff training for their emergency preparedness in case they had to stay on the job.
- We will work with community and business leaders to have a mutual agreement completed before an emergency.
- I will look at staff home planning for emergencies. Will encourage them to make a plan for their family in case they have to stay at the facility for a long period.
- We had missed a couple of steps in our redundancy planning but will be taking action to correct them.
- We, as a team, will be addressing several opportunities.
- Be aware of what our Emergency Sector has to offer to help.
- Continued improvement is required in the areas of planning and preparedness within the organisation and community.
- I'm not sure I understand this question.
- Ensure we know the steps to get us to 'Well Prepared'.
- We are working to have different sectors of businesses, government, and critical infrastructure to communicate during disaster scenarios.
- Preplanning will become better worded and detailed so that there are less confusion and more effective strategies.
- Continue to increase preparedness and collaboration with local and regional partners.
- Looking at service and supply contracts; more emphasis on personal preparedness so that employees can focus on institutional response and recovery.
- We need more plans set up to give assistance if needed during an emergency.
- We will create a disaster preparedness plan specific for our family and obtain the materials needed to execute on that plan.
- Enhance information sharing.
- We will be adding meetings and discussions.
- Enhance information sharing.
- More planning and always having a plan B!
- We will improve our plans.
- We need to have more alternate providers of emergency supplies.
- Experience in collaboration between offices.
- Develop mutual aid agreements.
- We need to have a concrete plan in place that is specific to our organisation's needs.
- We will re-evaluate our plan to ensure items are addressed that came up in this exercise.

- We will be gaining a better understanding of our mutual agreements with vendors and partners, overhaul, and updates to our water management plan for improved resilience.
- We found weaknesses in areas we need to improve.
- We will be adding additional training, implementing new SOP's, and exploring more resources that can help with resiliency planning.
- Relief strategy and material resource strategy.
- Personally, this was my first exercise at this company, so I can't compare it to others here. However, I learned a great deal and will take those learnings into the next drill or emergency.
- We will be investigating some of our resource plans to make sure we would really be able to have access to the resources we would need in the case of an actual emergency.
- We need to do more emergency exercises in our department.
- Improve communications before a full disruption.
- We will reevaluate our current procedures and in-depth expansion into some critical care areas.
- We will attempt to have more things on hand that are essential to life and death.
- Preparedness of our employees before a community event is key to their understanding of how an event can impact their family, their capabilities to offer support to their neighbors, and return to work to provide critical services to those impacted by the event.
- We are looking into local groups for communication support.
- Yes, increase awareness with staff and patients.
- We are going to be making some changes to emergency procedures.
- We are looking at more long-term planning for disasters.
- We need to strive for more complete and robust emergency supplies for an extended disaster.
- We need to strive for more complete and robust emergency supplies for an extended disaster.
- Ensure the document is available and easy to read.
- Continued education.
- We will look to further facilitate and collaborate with all departments and community stakeholders, as well as our mutual aid partners.
- Obtain a secondary source of fuel for our apparatus. But sufficient funding may be a hurdle.
- Working to have staff prepared. Working on single points of failure with critical facilities.
- More engagement with utilities and private industry.
- Double checking that we are prepared for responses. This type of training is much better than listening to a PowerPoint.
- We are working on better relations with stakeholders and plans.
- Re-visit our early warning and self-deployment planning. Also, review our equipment inventory and requirement in such a situation.
- Need a backup internet source — more supplies like water and food.
- Make improvements to our Continuity of Operations Plan and perform more drills and exercises at the local level.
- We will talk about adding family preparedness plans/communications to our self-help program.
- Taking a deeper and closer look at how main purpose, and not being sidetracked by issues that deter from that.
- Robust Communication Protocol, BCP mock drill.
- Yes, this exercise allows us to handle the situation professionally.
- We identified more details of preparedness that we add to our current BCP plan.
- Yes, we need to make sure we respond timely and effectively to them!!
- Update plans.
- We need to address the loss of NG and improve some MOUs.
- We will be tweaking out disaster plans immediately.
- We adjusted our tornado warning protocol to speed up our response to a tornado warning.
- I have offered my services to help build an area that I have experience in.
- We need to acquire additional low-tech backup options for multiple operational areas.
- More awareness = more engagement = improved planning and preparation.
- We find items in our EOP plans that need to be updated.
- We lacked in resiliency planning for some essential functions and creating a resilient staffing pool. The exercise gave insight to support those pieces.
- My box of supplies is nearly ready, yesterday I didn't have one!
- We made location forms, should we need to evacuate fast, I will be practicing this disaster more.
- I am going to use what I learned here for my organisation.
- I'm going to get an emergency kit ready and an emergency plan established with my family.
- More training.
- We will be developing better documentation and reviews of existing materials.
- Our organisation will reevaluate our current procedures and in-depth expansion into some critical care areas.
- We will definitely upgrade our emergency operations plan book.
- We are going to look into other means of communication in a black sky event.

- We have identified backup fuel will be needed.
- Our organisation is making some changes to our emergency procedures.
- Although we have a good plan in place, we created a to-do list of items that we need to follow up on to enhance the strength of our emergency plan.
- We will be strengthening our procedures and training around catastrophic disasters and will be seeking additional partners.
- We are looking into ways to improve this exercise for our organisation in the future.
- A number of our business continuity points require further updating.
- We will tweak our system test procedures to include emergency mode testing using the associate procedures on a more frequent basis.
- Now as an individual I can contribute my experience and knowledge for organisation growth
- I can contribute my knowledge and experience for organisational growth.
- We need to re-think how we would communicate if 'everything' went down during an emergency.
- Communication is key, which will be taking care of post the resilience in place, teamwork, cost and benefit analysis, decision making, timeline, and prevention measures.
- Some minor changes, such as including key points to consider in our crisis comms plan.
- Have a call list if something happens.
- Yes, we will take notes of this, and make sure to discuss this during the next BCP meeting.
- We will implement quick response teams, build awareness.
- Need a 30-day outage response plan for across the organisation, and more training.
- A concern with limited transportation and communication cut off is informing the public-- We are working on a better solution to this issue.
- Set aside provisions for long term layovers for staff in the event of an extended emergency.
- I have no power to make those kinds of changes here, but it will impact how I prepare at home.
- Directly impacts the client's After-Action Report, and Continuity of Operations Plan (COOP), Emergency Operations Plan (EOP).
- We will be incorporating emergency preparedness planning to our employee training to assist with employee shock and stresses. The better they are prepared, the better equipped they will be able to handle the situation.
- Our plant is under a large construction upgrade.
- We have posted as many phone numbers, maps, and books as possible and are less dependent on cell phones.
- We're planning to map out inundated areas for progressively higher flood levels to determine which assets will be underwater first, the criticality of that asset and if attempts should be made to harden that asset.
- We added Fuel and Food storage to our plans.
- Consideration of road elevations was important to route employees and suppliers.
- Making sure we have enough water, generator, and emergency contact lists.
- We need to be more detailed in contingency plans.
- Because we are expanding our facility, we must change and evaluate operations and placement of assets.
- Will perform more regular updates of the phone tree and more exercises of this nature.
- Take a better look at resources and how best to utilise them in performing our mission essential functions.
- We will use this information to drive a response drill.
- We need to have a contingency plan for a scenario like this, specifically with back-up communications devices to be able to navigate such a situation.
- Need for agreements with surrounding communities for supplies.
- I can pre-empt and plan things better to handle a difficult situation.
- Increase more of the employees' participation in the preparation.
- We need to be more prepared to deal with such situations like the ones in the exercise.
- We have some structure in place that we would use in an emergency.

THE RESILIENCE SHIFT

resilienceshift.org