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The Role of Contingency Planning in Climate Change Adaptation for the Forestry Sector in Scotland

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Summary

Contingency plans have the potential to increase adaptive capacity by enabling more rapid and efficient response to climate change risk events. As such, contingency plans provide economic benefits to forestry businesses, minimise the disruption to the natural environment, and support Scotland's forests in continuing to deliver the widest range of ecosystem services.

This paper considers when contingency plans are necessary, and explores which climate risks to the forest sector in Scotland may benefit from national or regional contingency plans.

1.1 Key findings

- Contingency plans can be a key risk management tool in efforts to reduce the level of risk from projected climate change.
- Contingency plans exist across the forestry sector in Scotland, containing pre-agreed processes to be followed in response to a particular risk event, e.g. tree health and windblow contingency plans.
- Contingency plans can reduce the impacts of a risk event by improving response and recovery times. This can save money and prevent further damage.
- Contingency plans are appropriate for risks which are medium or high impact, and in particular those which are also low likelihood or which have a high degree of uncertainty, as these factors may preclude, or act as barriers to, risk reduction through planned adaptation.
- By supporting post-event recovery, contingency plans increase the adaptive capacity of the forestry sector.

1.2 Recommendations

- Contingency planning should be part of the forest sector at all scales, from national and regional policy and planning to local application by forest managers.
- As templates for contingency plans are successfully used in other sectors (e.g. food and drink, climate change predictions), we suggest developing a template to assist forest managers in producing local contingency plans.
- In addition to the existing contingency plans for wind damage and for pest and pathogen outbreaks, plans should cover wildfire, drought and flooding.
- Contingency plans in the forestry sector should include projected impacts on infrastructure and forest businesses, and on important conservation habitats.

Contents

2 Introduction to Contingency Planning

2.1 What Are Contingency Plans?

Contingency plans describe how an organisation or sector will respond should a 'risk event' occur. In forestry, a 'risk event' could be any event that results in economic loss or environmental damage, including wildfire, severe drought, wind storms, and pest or pathogen outbreaks. Contingency plans contain an agreed course of action designed to reduce the negative impacts and support recovery. Contingency planning for climate change specifically refers to the plans made in preparation for current and future risks, directly or indirectly related to the changing climate.

2.2 Why Do We Need Contingency Plans?

A wide variety of risks exist to which forestry and related sectors may be vulnerable. The consequences of a risk event occurring may be acceptable or unacceptable, depending on the nature of the risk and the level of risk tolerance of the organisation. The risk management process seeks to reduce risk to an acceptable level. In the context of climate change, this risk reduction process is a major component of adaptation. Sometimes the level of risk remains unacceptably high even after risk reduction measures have taken place, while on other occasions it may not be possible to reduce the level of risk in a suitable timeframe, or at all. Where the level or consequences of a risk are unacceptably high, contingency plans can help manage the impacts of a risk event and facilitate post-event recovery.

Contingency planning should not discourage proactive adaptation, it reflects that risk cannot usually be eliminated, adaptation to reduce risks is not always possible or desirable, and that advanced planning for response and recovery can offer many benefits. Contingency planning forms part of a strategic approach to risk management, and increases resilience by enhancing an organisation's or sector's ability to recover following a risk event. When viewed in this way contingency plans are not a plan B, they are an essential component of plan A.

2.3 The Benefits of Contingency Planning

There are many readily apparent benefits of contingency plans to businesses, such as financial savings and a more rapid return to business function. A successful contingency plan can support recovery following a risk event by delivering a more rapid and organised response, and if a risk event can be identified early can minimise further impacts. Contingency planning can ensure a more rapid response, as decisions about when and how to respond have been made and agreed in advance. Thresholds and trigger points can be decided and therefore acted on quickly and with agreement. The response can be better organised and more effective, as plans can be better prepared as there is time to collect information and research options. Decision making will be more thorough as it is not hurried or made under pressure. Individuals within an organisation are informed about the risks, prepared in advance for the responses required, and key players can been identified and assigned responsibilities. Where a multi-agency response may be necessary the appropriate communication channels and chain of command can be established, individuals can be identified and assigned responsibility, and decision making criteria and response options agreed in advance.

As well as benefits to forest businesses, contingency planning in the forestry sector can minimise the impacts to the natural environment and allow forests to continue to deliver a wide range of ecosystem services, such as allowing a more rapid return to recreation access and carbon storage and sequestration.

Figure 1 illustrates the benefits of contingency planning by showing the impact of a climate event on a system (i.e. ecosystem or business) and the recovery after the event. From a 'good' baseline, a climate event damages the function or condition of the system which deteriorates. If the impact is gradual and an early warning system is in place, contingency planning may prevent further impacts

and increase recovery time (purple line). If the impact is rapid there may be no possibility to reduce the degree of impact, but with advance planning recovery time will be faster (green line). Without contingency planning recovery will take longer (blue line).

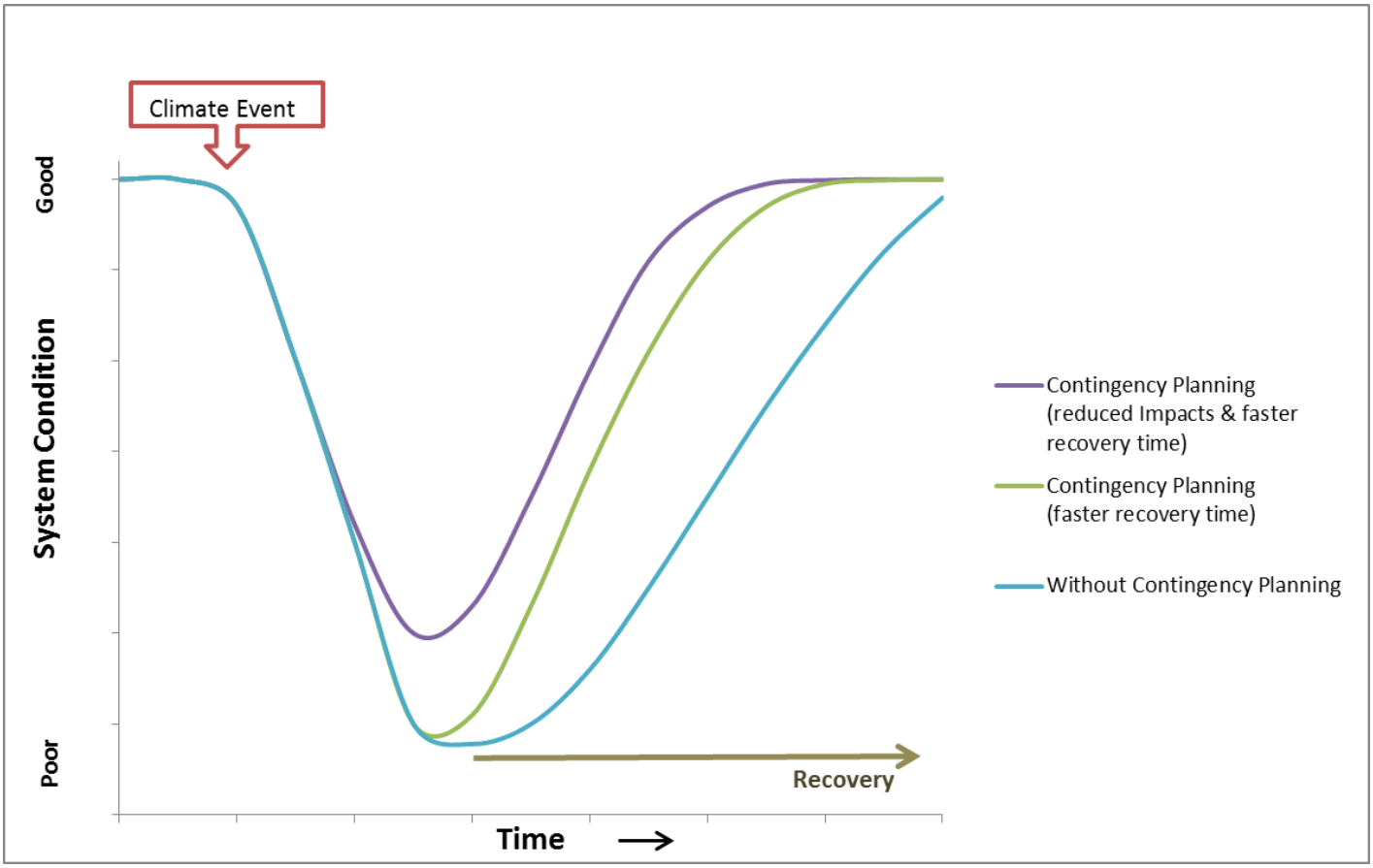

Figure 1: The benefits of contingency planning. This figure illustrates the impacts of a damaging climate event on a system (forest ecosystem, business etc.) and shows recovery over time with contingency planning (purple, green) and without contingency planning (blue)

2.4 Contingency Planning for Climate Change

Adaptation involves changing actions and behaviour in response to, or in advance of, climate change, to take advantage of positive opportunities and to avoid or reduce the impacts of negative threats. The field of risk management focuses on reducing both the likelihood and impacts of negative threats, and increasingly overlaps with adaptation. Contingency planning forms a key component of a risk management programme, and therefore has a critical role to play in adaptation. In addition to reducing the level of risk, adaptation actions can also increase adaptive capacity, which is the degree of disturbance a system can accommodate and still recover from. Increasing adaptive capacity also includes supporting post event recovery; contingency planning therefore supports adaptation by increasing adaptive capacity.

Climate change is projected to increase the level of some current risks and bring about new risks to the natural environment (Brown *et al.*, 2016), economy and infrastructure (Dawson *et al.,* 2016), and business & industry (Surminski *et al.,* 2016). There may also be interactions between different risks which make the impacts larger (Street *et al.,* 2016). Both the current and future level of risk need to be considered in climate change adaptation.

While uncertainty and change are familiar concepts in business planning and risk management, climate change may pose additional challenges. Climate change risk assessments often have high levels of uncertainty and high levels of projected change. Not every risk can be known or accurately

projected, but an additional benefit of having contingency plans in place is that they may also support management following unknown or unexpected risk impacts. This is particularly useful in facing climate change, where some risks may be unknown.

Individual contingency plans are recommended for all major climate risks, as the impacts and response to each will be different. However, some of the content, principles, and named individuals will overlap, therefore contingency planning for one risk can assist with the preparation of other plans and the response to other risk events.

2.5 Contingency Planning for the Forestry Sector

The forestry sector faces a number of unique challenges in climate change adaptation and specifically contingency planning. Forests are a natural resource and are managed for a wide range of objectives: financial, environmental, recreational, cultural or historical; and often multiple objectives are achieved by one forest. This makes decision making more challenging than where a business is primarily financial in its objective.

Forestry in the UK typically has long rotation lengths (50+ years), which means that the level of many risks will change with time, both as a result of climate change as well as stand age and management. Future risks must be considered during planning, especially during the planned length of the forest rotation. Forest management also requires long lead times in making changes, both due to planning and regulations, and to the nature of management; one obvious example is that it takes considerably longer to harvest a forest stand than to harvest an agricultural crop.

When assessing climate change risk and developing contingency plans it is important to look beyond impacts of the natural environment and consider the wider impacts of climate change and how these might affect the forest business. Some climate risks will impact the forest itself, whilst other risks may impact power supply, transport, & communications, business finance, product distribution, supply chains, global timber markets, material and product availability and price. For some businesses, contingency planning for climate change will overlap with business risk management and business continuity planning.

In addition to the impacts on the forest and forest businesses, forestry sector contingency planning should consider impacts on other sectors and include an element of cross-sector planning.

3 When Are Contingency Plans Necessary?

Contingency plans are valuable when an unacceptable level of risk exists currently or is likely to increase in the future, but where it is not possible or practical to reduce the level of risk to an acceptable level. Instead the focus is on minimising impacts and preparing for post-event recovery. Whether or not a contingency plan is necessary depends on the nature and severity of the risk in addition to other factors, such as the risk tolerance of the organisation, type and extent of planned adaptation actions, likelihood of success, and the cost versus benefits of contingency planning. The decision making process is best made as part of a risk management framework.

3.1 Understanding Risk

There are many different definitions of risk; the most commonly applied to climate change adaptation and risk management in the forest sector is that risk can be viewed as a combination of both the impacts of a risk and likelihood of that risk occurring (Figure 2, HMO Treasury, 2004; IPCC, 2014). The initial level of risk is known as the ‘inherent risk’, whilst the ‘residual risk’ is the level of risk after risk reduction measures have been implemented. Climate change adaptation can reduce risk by either reducing the impact or the likelihood of the risk.

Figure 2: Risk can be defined as a combination of the severity of impact and likelihood of the event

The full spectrum of risks can be viewed in a risk analysis matrix (Figure 3), where the consequences range from negligible to catastrophic and the probability from remote to almost certain. Whether or not a contingency plan is required will depend partly on where within the matrix the risk falls, both before and after planned adaptation. High impact risks are more likely to benefit from contingency plans (yellow circled area). Adaptation actions may reduce either the consequences or likelihood of a risk, moving the position within the matrix. When assessing the need for a contingency plan the decision may also depend on the projected position of the risk within the matrix after appropriate adaptation actions have been implemented.

Risk Analysis Matrix		Likelihood (Probability)				
		Remote <10%	Unlikely <30%	Likely ~50%	Highly Likely >70%	Almost Certain >90%
Impact (Consequence)	Catastrophic	M	M/H	H	H	H
	Serious	L/M	M	M/H	H	H
	Moderate	L	L/M	M	M/H	H
	Minor	L	L	L/M	M	M/H
	Negligible	L	L	L	L/M	M

Figure 3: Risk Analysis Matrix showing the full spectrum of risks. The severity of impact ranges from catastrophic to negligible and the likelihood from remote to almost certain. The yellow highlighted region highlights where contingency plans may be beneficial

High-impact and high-likelihood risks are likely to require or justify risk reduction measures. However, contingency planning may be beneficial even where it is agreed that such measures are required, should these turn out to be insufficient, or take too long to reduce the level of risk, or if an unexpected barrier should arise. This may be particularly the case for forestry because of the complexity of managing the natural environment for multiple objectives, and where the rate of change can be slow due to long rotation lengths.

High-impact and low-likelihood risks are most likely to benefit from contingency planning, as risk reduction actions may not be possible or desirable, or the uptake of other adaptation actions may be slow. Whilst prevention is better than response, many factors influence decision making for risk management and can act as barriers to adaptation, these may be: practical or financial constraints; conflicts with other targets, values or priorities; social, political or institutional barriers to change; or a lack of confidence or high levels of uncertainty. The cost of adaptation may outweigh the benefits, either financially, or where strong ecological or cultural values are attached to an ecosystem.

Moderate impact risks may benefit from contingency planning depending on the cost-benefit trade off of planning vs projected impact. The level of detail in a contingency plan can vary, and lower impact risks may benefit from, and justify, a contingency plan with less detail but with easy steps that can be taken to support post event recovery.

3.2 Risk Management Framework

Businesses routinely face a wide range of risks, and risk management forms an essential component of business continuity and health and safety strategies. A standard risk management framework comprises five steps and is shown in Figure 4: risk identification, risk assessment, selecting a risk management strategy, implementing the agreed strategy, and continued monitoring and evaluation.

Figure 4: Five stages of a standard Risk Management Framework

These same stages of risk management can be applied to climate change risk management and form a framework for strategic adaptation (UKCIP, 2013). Risk based approaches to climate change adaptation are increasingly common, including the national approach to risk management and adaptation, which includes the UK Climate Change Risk Assessment (https://www.theccc.org.uk/tackling-climate-change/preparing-for-climate-change/uk-climate-change-risk-assessment-2017/), Scottish Climate Change Adaptation Plan (Scottish Government, 2014), and monitoring procedures including adaptation indicators (ClimateXChange, 2016) and progress reports (Committee on Committee Change, 2017).

3.3 Risk Management, Adaptation and Contingency Planning

Climate change adaptation activities take place under Step 4, “implementing the risk management strategy”, although is interdependent on all stages within the cycle. Depending on the nature of the risk, management objective(s) and attitude to risk, the risk management strategy selected at Stage 3 may be (adapted from the “Orange Book” of Risk Management, HM Treasury, 2004):

- reduce the risk (plan adaptation action)
- prepare a contingency plan
- take advantage of the risk (seeing the risk as an opportunity to gain a benefit)
- tolerate the risk (accept consequences)
- transfer the risk (portfolio management)
- terminate the activity
- collect more information before making a decision (whilst continuing to monitor the risk)

Not all options are mutually exclusive and it is possible that multiple actions will be carried out. For example, it may be appropriate to implement a risk reduction action and a contingency plan, or to

carry out an adaptation action whilst carrying out further research. It should be noted that not all options are available to all forest owners or managers. For example, it is not possible for everyone to transfer the risk by selling and purchasing another forest or by felling/moving the forest to another location, or to terminate the activity by selling the forest or changing to another land use.

Decisions for risk management will need to be made on a case by case basis, in light of the management objective, attitude to risk, nature of the risk (impact and likelihood) both current and future, degree of uncertainty, and the type and likely success of any planned adaptation action. The size, experience and financial capacity of the organisation will also impact the decision.

Regardless of the decision made, even if it is to take no action, the rest of the risk management cycle is still essential; the impacts must be monitored, the risks re-evaluated and the risk assessment revised at a predetermined interval, or sooner if circumstances change.

3.4 Current & Future Risk

Climate change is projected to increase some current risks and bring about new risks. When assessing risk, either the highest level of current or future risk can be used to make decisions regarding adaptation including contingency planning, or assessments can be made on current levels of risk with future risk incorporated as the risks are re-evaluated. The nature of the risk, uncertainty surrounding the risk, and the rate of projected change will be significant factors in decision making.

Some climate change risks are projected to change quite slowly and others more rapidly. Slow changes to the level of risk, such as changes in tree species suitability as a result of increasing mean annual temperature and changes in seasonal rainfall patterns, can make determining the current need for adaptation actions such as risk-reducing measures or a contingency plan more difficult. Gradual changes are harder to recognise and it is more difficult to decide when to respond.

For other climate risks, many of which are already current risks, events occur with very little advance warning, but a ‘return period’ that can be estimated, for example, with storm damage or flooding. As the exact time of these events cannot be predicted, having a contingency plan in place can be invaluable to aid in recovery.

The level of some risks also varies with stand age and as a result of stand management. For example, forests are more susceptible to flooding and drought during establishment, to wildfires during the thicket stage, and wind damage after thinning and as they approach felling age. This variation must be accounted for in risk management planning.

3.5 Risk Interactions

The level of certain risks may also increase as a direct consequence of other risk events, or there may be interactions between different risks which makes the impacts more serious. For example the risk of a pest outbreak may increase after a wind blow event, especially if there is a delay in clearing, and the risk of wildfire increases during spring and summer months after a pest or disease outbreak or following a drought. Further evaluation of the need for contingency plans and early warning/detection systems may be needed following other risk events. These changes can be detected by re-evaluating the risk assessment and stages of the risk management framework following a risk event.

Adaptation actions which reduce one risk may increase the level of another risk if they are not well planned, resulting in maladaptation, so it is important to evaluate all climate risks to a forest.

4 Climate Change Contingency Planning for Scotland's Forestry Sector

Contingency planning for climate change risks can be considered at a UK wide, Scottish, regional or local level, depending on the scale of the risk, type of response required and the type and scale of forest ownership.

4.1 National and Regional Plans

Risk management and contingency plans are in place for the UK for tree health and for windblow in Scotland:

- Tree Health Contingency Plans (UK) plans are available for specific pests/pathogen, a universal tree health contingency plan is under development
- Scottish Windblow Contingency Plan (Scotland)

It should be noted that tree health and wind blow are included as they are interrelated with climate change. Changes in temperature and rainfall distribution are projected to increase the stress levels of some forest stands in particular areas, and modify the distribution of some pests and pathogens. In combination with changes in tree species choice, this may result in opportunities for new pests or pathogens, new host-pest/pathogen combinations to become established, or conditions for existing pests or pathogens to outbreak. Whilst the impacts of climate change on wind risk are uncertain, changes in climate may increase the vulnerability of stands to wind throw through faster growth rates and wetter soils in winter.

Climate change risks to the natural environment which may require contingency plans in Scotland:

- Wildfire (urban forests; assessment after severe droughts or tree health damage). *[Note: There is information on wildfire resilience at a UK level in Building Wildfire resilience into forest management planning]*
- Flood (catchment based assessment)
- Drought (east of Scotland)
- Invasive species (plant & animal species)

In addition to specific risks, valuable habitats such as native Scots pine woodland and Atlantic Oak woods may benefit from specific risk assessments and contingency plans.

Climate change risks to infrastructure and business operations which may require national or regional contingency plans:

- Transport disruption (from flooding, wind storms, heat, landslides) affecting nursery material, timber, vehicles and forest machinery, affecting forestry and processing operations; also staffing levels and productivity.
- Damage to forest infrastructure (roads, bridges, culverts) from floods, wind, heat & landslides
- Disruption to power supplies affecting business productivity, communications, light & heating
- Disruption to communication networks (phone, internet & email) affecting business operations
- Staff health, safety & productivity affected by extreme weather events
- Disruption to business supply chains (product availability, customer demand)

4.2 Local Contingency Planning

A risk assessment, accompanied where necessary with adaptation actions including contingency planning, is a requirement for forest management under the UK Forest Standard (Forestry

Commission, 2017). The risk assessment should be documented as evidence of decision making and systematic risk management.

The same climate change risks as at a national level should be assessed locally:

- Wind throw
- Wildfire
- Flood
- Drought
- Pest and disease outbreaks
- Invasive species (plant & animal species)

Likewise, the risks to infrastructure and business operations detailed above will require a site based assessment.

4.3 Risk Assessment & Contingency Planning Templates

Risk assessment templates have been developed to support climate change adaptation decision making, such as the UKCIP Wizard (UKCIP, 2013) and the guidance for the Food and Drink sector (Climate Ready, 2013).

A contingency planning template may be developed to support managers to prepare plans, such as the SEARS: Contingency Plan for the Outbreak of Notifiable Disease (Scottish Government, 2010).

5 Components of a Contingency Plan

If a risk assessment determines that a contingency plan could be beneficial to a forest site or forestry business then the following considerations may be beneficial in developing a contingency plan. A summary of potential content is included in the Appendix.

5.1 Level of Detail

The nature of the contingency plan will vary from simple to complex depending on the level of risk, the potential scale of the projected impacts, and the degree of uncertainty. Developing a plan will vary from low to high input; the higher the degree of preparation for the contingency plan the more effective the planned response may be, but the cost and time requirements will be greater. Generally, higher impact risks will require and justify a greater level of planning. In some cases it may be possible to over-plan, and the impacts of the risk not be realised during the life of the plan.

5.2 Early Warning Systems

Risk events vary in their rate or impact; some risk events will unfold slowly allowing time for intervention, whereas others will impact rapidly which will change aspects of the contingency plan. For example, early detection of a forest pathogen may provide an opportunity to activate a prepared plan and prevent further spread. Other risks may occur too rapidly for any advance planning to reduce impact, but contingency plans will still be beneficial to the nature and speed of the recovery process.

The amount of early warning available for a risk will also affect the content of the contingency plan and the benefits it can provide. Early warning of elevated risk conditions can trigger a state of high alert with increased levels of vigilance and monitoring. For example, early warning of dry conditions may allow an increase in monitoring in areas vulnerable to forest fires, which could detect a small forest fire before it spreads. However, whilst it may be possible to give some advance warning for other risks such as a wind storm, this provides little benefit to the forest manager as it not possible to reduce the level of risk in the time available. It does however provide an opportunity to prepare in advance for post event recovery, for example clear up of wind blow.

The majority of climate change risks to forestry will have some advance warning period to allow either early detection or some degree of preparation and planning which can be included in a contingency plan. Incorporating monitoring and early detection into risk management and climate change adaptation strategies should allow timely and well organised responses that would help to reduce the impact.

5.3 Stages of the Plan

Planning for the prevention of, and response to, a climate risk event can be considered in different stages (figure 5); some apply before the event and some after. Some adaptation actions (aiming to reduce the likelihood or impacts of a climate risk event and preparing for post event recovery) will take place well before the event. It may also be possible to trigger a state of 'early warning' with increased levels of monitoring in response to pre-agreed triggers. If an early warning system is in place then preparations will also need to be made for a 'rapid response'; although these two stages may be absent from some contingency plans. There is also the main 'prepared response', which will be common to all contingency plans, and the 'end of plan'.

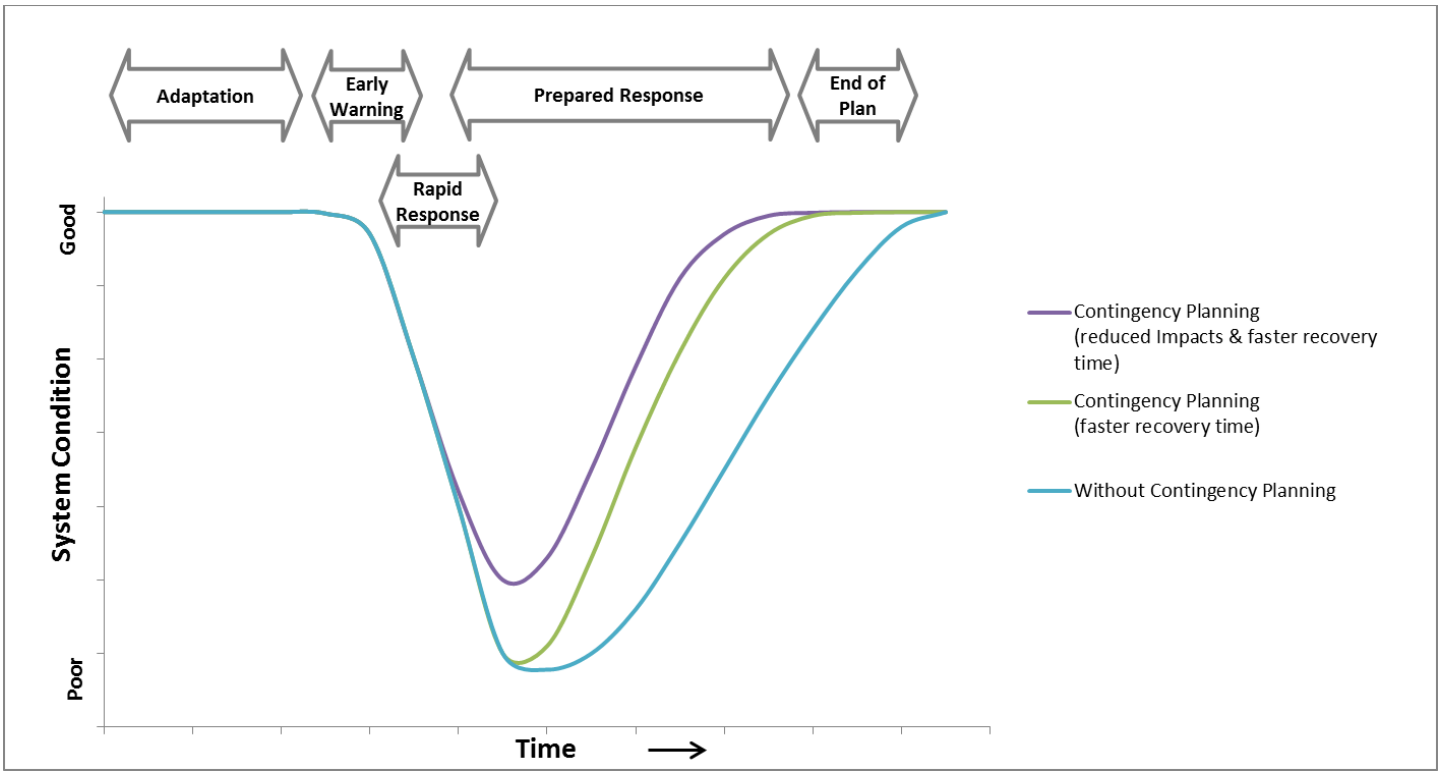

Figure 5: timeline for stages of preparation and response to a damaging climate risk event if a contingency plan is in place.

6 Conclusions

Contingency planning plays an essential role in climate change adaptation for the forestry sector in Scotland. Contingency plans have the potential to increase adaptive capacity by enabling more rapid and efficient response to climate change risk events. As such, contingency plans provide economic benefits to forestry businesses, minimise the disruption to the natural environment, and support Scotland's forests in continuing to deliver the widest range of ecosystem services.

Contingency plans are most valuable for risks which are high impact but low likelihood, or where planned adaptation is not possible or desirable. The decision making process is best supported by a risk management framework which considers the degree and nature of the risk and possible adaptation actions.

National or regional contingency plans for the forest sector may be beneficial for wildfire, flooding and drought, in addition to the wind-risk plan that is already in place. Sensitive and valuable woodland habitats such as ancient Scots pine forests and Atlantic Oak woods may also benefit from specialised plans. In addition, exploring the projected impacts of climate change to Scotland's national infrastructure and economy and the impact these may have on forest businesses and the forestry supply chain is recommended. Re-evaluation of the level of some risks may be needed following other risk events, as the level of subsequent risk may increase, for example for pest outbreaks after wind blow events, or increased fire risk after a pest or disease outbreak or drought. Provision of a contingency planning template for forest managers and forest businesses would encourage development of local plans and support resilience across the forestry sector.

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9 Glossary

Definitions are taken from the International Panel on Climate Change 5th Assessment Report Working Group II Glossary (IPCC, 2014) unless cited, or marked with an * indicating a definition from this document. Multiple definitions have been included where they might be beneficial.

Adaptation: involves changing actions and behaviour in response to, or in advance of, climate change, to take advantage of positive opportunities and to avoid or reduce the impacts of negative threats. *

Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

> **Incremental adaptation**: Adaptation actions where the central aim is to maintain the essence and integrity of a system or process at a given scale.
>
> **Transformational adaptation**: Adaptation that changes the fundamental attributes of a system in response to climate and its effects

Adaptation deficit: The gap between the current state of a system and a state that minimizes adverse impacts from existing climate conditions and variability.

Adaptation limit: The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions.

Adaptive capacity: The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Contingency plan: A pre-prepared plan detailing how to respond should a risk event occur. The plan pre-agreed criteria to activate the plan and includes actions that will reduce and manage the negative impact of the risk event, with named individuals and allocated responsibilities.*

Early warning system: The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of harm or loss.

Extreme weather event: An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

Maladaptive actions (Maladaptation): Actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future.

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions. (IPCC, 2012)

Resilience: The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change. (Forestry Commission, 2011)

Resistance: Refers to the ability to avoid suffering significant adverse effects. (IPCC, 2012)

Risk Event: the specific occurrence of a risk; where a vulnerable system is exposed to a physical hazard, in this context as a result of climate change. (DIY)

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard.

- **Vulnerability**: the propensity or predisposition to be adversely affected (also see below).
- **Hazard:** the potential occurrence of a natural or human induced physical event that may cause negative impacts. A physical event becomes a hazard when a system is exposed to an event and is in a vulnerable condition.
- **Exposure:** the presence (location) of people, resources (etc) in places which could be adversely affected by physical events, and which are subject to future damage.

Risk: uncertainty of outcome, whether positive opportunity or negative threat, of actions and events. It is the combination of likelihood and impact, including perceived importance (HM Treasury, 2004).

Inherent risk - level of risk before any management action is taken (HM Treasury, 2004).

Residual risk: The level of risk remaining after action has been taken to manage it, making the assumption the action is effective' (adapted from the HM Treasury, 2004).

Risk assessment: The qualitative and/or quantitative scientific estimation of risks.

Risk management: Plans, actions, or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.

Risk management: 'Risk management is a structured approach to identifying, assessing and controlling risks.' 'Its purpose is to support better decision-making through understanding the risks' 'and their likely impact'. (HM Treasury, 2011)

Uncertainty: A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g., a probability density function) or by qualitative statements (e.g., reflecting the judgment of a team of experts)

Uncertainty: An expression of the degree to which a value or relationship is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. Uncertainty may originate from many sources, such as quantifiable errors in the data, ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgment of a team of experts. (IPCC SREX)

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

> **Sensitivity:** The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change.
>
> **Inherent/Initial vulnerability** describes the initial level of vulnerability
>
> **Residual vulnerability:** the level of vulnerability after adaptation measures have been implemented.

Vulnerability assessment: the analysis of the expected impacts, risks and the adaptive capacity of a region or sector to the effects of climate change. Vulnerability assessment encompasses more than simple measurement of the potential harm caused by events resulting from climate change: it includes an assessment of the region's or sector's ability to adapt.

Windblow: the uprooting of trees by wind.

10 Appendix: Contents of a Contingency Plan

The following content may be included in a contingency plan for a forest site or forestry business. It should be noted that this list is a starting point and is not comprehensive; specific risks, sites and situations will require. Additional content will become evident as plans are developed.

10.1 General Content

Some content will be common to most or all contingency plans. Information in this section may be included in forest management plans or other documentation, in which case external content can be linked to the plan.

Organisation/Forest Management Objectives – This helps determine the goal(s) of the plan. This may be a summary and a link to external document(s).

Objectives of the Contingency plan - What the plan aims to achieve, i.e. protect the health and safety of staff and the public, minimise damage to the natural environment, minimise the area of forest to be felled, support business continuity, minimise adverse impacts on the rural and wider economy, the public, rural communities and the environment.

Extent of the plan- The geographic area covered by the plan, whether National, regional, or local. It may include a map of the covered area(s) and a site map if for one forest site/business.

Scope of the plan- Define what is and isn't covered by the plan

Where the contents of the plan are stored – external files/locations. Collect file names/ location of the information in a master file. Hold a copy of the plan and contents off-site

Owner of the Plan – named individual and organisation, contact information.

Other key individual(s) – names, contact information and roles.

List of responsibilities – for which the plan owner and key individuals are responsible.

Communication routes – internal and public. Who should be contacted and under what conditions.

Contact information – all staff, neighbouring businesses, other organisations etc.

Communication Strategy - channels for sharing relevant information. Customer and supplier contact information. National reporting, if necessary e.g. Online/website/twitter channels.

Triggering a contingency plan – what criteria warrant the contingency plan being activated?

Early Warning and High Alert Status – can a state of high alert be i) useful ii) detected? Criteria for initiating and ending a state of early detection and monitoring.

When to end the contingency plan – criteria for ending the plan, including a hand-over plan and a 'lessons learned' review/report is completed. This could be: when the action has succeeded and goals have been met or a long term management plan is in place; or the plan has failed and an alternative solution is agreed; or if/when another team is established to handle the situation.

Plan maintenance - when to review the plan. Annual update and regular (i.e. 5 yearly) review. criteria for when an early update/review may be required.

Links to relevant legislation – if appropriate. Specific to different risks, countries and sites. i.e. UK Forest Standards & environmental legislation.

Business continuity plan – link to relevant other plans if the risk event impacts business operations. Alternative office location/communications channels/IT facilities/online backups/home working. Product distribution/supply distribution – contact information, alternative suppliers, product/stock reserves.

Budget – details may or may not be included in the final plan but will be essential in determining the level of advance planning. Budgets may be assigned to different stages of the plan. Details of who is responsible for budgeting, who controls the budget, and review points.

Understanding and managing impacts - to the: forest, business, health & safety, public and other stakeholders. This will form the main body of the plan and will include content that is site and risk specific.

10.2 Local Plans: Site Specific Details

This content may be particularly relevant for local plans, but some information may be summarised in regional and National plans.

Forest Inventory Information – age, species, site conditions, soil type, slope, aspect, ESC category to aid in replanting.

Forest Access Information - road, maps, gates, lock information, GPS co-ordinates, access information, road surfaces, water intakes/storage, power lines, power switch, public footpaths or rights of way.

Neighbouring sites - details and contact information for neighbouring or on-site land, forest, businesses, residential properties etc.

Protection/licences – Tree Preservation Order or felling licence requirements, application forms

Endangered species on site – Measures for protecting red squirrels, bats, newts, etc.

10.3 Risk Specific Content

- Fire
- Tree Health
- Wind
- Flooding/extreme rainfall
- Landslides