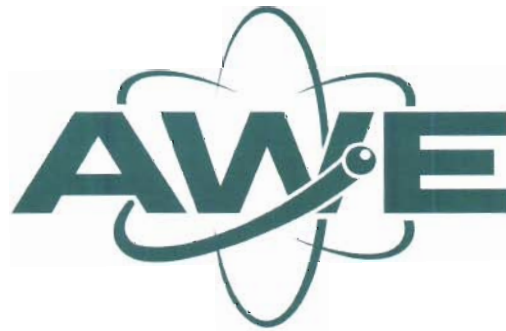




**RLI Assessment of
Extreme Weather Events on
AWE Sites (Flooding)**

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**Review Learn & Improve Assessment
of
Extreme Weather Events on AWE Sites (Flooding)**



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12(3)

12(5)(a)

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Executive Summary

1. Following the wettest summer recorded since 1912 in England and Wales as a whole, the Atomic Weapons Establishment (AWE) sites experienced severe adverse weather on the 20th July, which delivered approximately twice the average monthly rainfall for July in a 24 hour period. The majority (90%) of the rainfall was during a 5-hour period (07.30 – 12.30) on the morning of the 20th. Based on available data the [REDACTED] 12(5)(a) facility based at [REDACTED] estimated the event as a 1 in 215-year return event. The extreme levels of rainfall resulted in ground flooding at the AWE sites and significant areas of Berkshire and Hampshire.
2. The AWE (A) North Ponds Surface Water Management System operated well, although ground flooding was experienced in localised areas of the Aldermaston site. The flooding caused no long-term disruption to the AWE (A) site operations or capability although the site telephone exchange [REDACTED] suffered substantial water ingress through service penetrations below ground level and only the prompt action of the Fire & Rescue Service kept the facility operational. The AWE (A) site quickly regained full operational status following the incident.
3. However, the AWE (B) site experienced significant ground flooding throughout substantial areas of the site, which had an immediate impact on site facilities and resulted in longer-term disruption. The Licensed Site (LS), [REDACTED], Explosives area and 10A area within the AWE (B) establishment were severely affected by floodwater ingress, causing extensive damage. The recovery operation has been well planned and executed with site wide support and co-operation evident. This is the first time that the LS has experienced any significant flooding impacting on capability since the current contract arrangements have been in place.
4. The Abnormal Event (AE) investigation report commended the actions of personnel involved in the initial response to the incident and concluded that, due to the scale of the event, little more could have been done at the time of the incident to prevent the damage which occurred. The AE investigation report raised four (4) non-conformance reports (NCR's).



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5. The Director Stockpile Management (DSM) and the Director Infrastructure (DI) commissioned a Review, Learn & Improve (RLI) assessment by a cross-directorate team to review the incident. Terms of Reference for the RLI assessment team were agreed to review this event, previous similar events and determine potential areas for improvement.
6. The RLI assessment considered a wide variety of topics with company subject matter specialists examining areas of interest within their fields of expertise. The team has made 43 recommendations, which highlight actions required and areas warranting further investigation.
7. With the proposed development of the AWE site's capability to support the national defence strategy, probably the most important issue is the level of flood risk that can be tolerated for new non-nuclear facilities that support our nuclear facilities to deliver the national and corporate objectives. This issue should be addressed quickly to minimise any impact to proposed projects from a possible amendment to flood risk design criteria and provide a long-term solution.
8. It should be noted that at no time during the storm event on the 20th July, resultant flooding or initial clean up was there any threat to the nuclear safety of either the AWE sites, the public or the environment.



1.0 Introduction

1.1 On Friday 20th July 2007 severe adverse weather resulted in the AWE Sites (Aldermaston (A) & Burghfield (B)), and surrounding areas, experiencing extreme levels of rainfall a consequence of which was ground flooding at both sites and neighbouring properties. The AWE (A) North Ponds Water Management System (NPWMS - [REDACTED]) 12(5)(a) operated well although ground flooding to localised areas of the site was experienced, but caused no long-term disruption to the site operations. However the AWE (B) site experienced significant ground flooding throughout substantial areas of the site. This flooding had an immediate impact on site facilities and operations and resulted in longer-term disruption to operations.

2.0 Weather Conditions (20th July 2007)

2.1 The main weather feature of the summer (2007) was the high rainfall experienced in many regions of England, especially during June and July. England and Wales as a whole experienced the wettest summer since 1912. Meteorological Office data⁽¹⁾ shows that the 1971 to 2000 average rainfall in the South of England for the month of July is 48.8mm. Available local data recorded 92.6mm of rainfall from Thursday 19th to Friday 20th July (24 hour total), with 83.5mm falling between 07.30 and 12.30 on Friday 20th July. The Meteorological Office data for June (1971 to 2000) averages shows a monthly total of 59.5mm. Again local data recorded a total of 108.3mm rainfall during June 2007, nearly twice the seasonal monthly average.

2.2 The figures show that approximately double the average monthly rainfall for July occurred during the period of 19th – 20th July 2007, with 90% of that rainfall experienced in a 5 hour period on the morning of the 20th July. With rainfall figures for June also being approximately double the average, the antecedent conditions had saturated both the sites and surrounding catchment areas with the effect that run-off from permeable areas was quicker than during usual conditions.

2.3 The [REDACTED] estimated the weather event on the 20th 12(5)(a) July to be an event with a return period in the region of 1 in 215-year, based on information provided by AWE and the Flood Estimation Handbook (FEH). [REDACTED] [REDACTED] note that this figure should be further assessed when relevant information (rain gauge and radar data) becomes available from the Meteorological Office.

Recommendation No. 1

Commission [REDACTED] to re-assess the event when official Meteorological Office information (rain gauge and radar data) becomes available and provide AWE with “official” assessment of the event.

3.0 Abnormal Event Investigation

3.1 In accordance with AWE Company Safety Instruction (CSI) 603⁽²⁾ an Abnormal Event (AE) report⁽³⁾ was raised and the Extreme Weather Event investigated. The AE report commended the actions of personnel involved in the response to the incident and concluded that, due to the scale of the event, little more could have been done at the time to prevent the damage which occurred. However the AE Investigation did identify some areas of deficiency and four Non-conformances (303 Reports) were raised as an output of the AE investigation, which are identified below.

- NCR 1)** The complexity and widespread nature of this incident would benefit from a more comprehensive RLI activity to ensure all the key issues are fully addressed.
- NCR 2)** Contact information for key staff required as part of emergency response arrangements was not up to date. (Remedial Action completed 21/09/07)
- NCR 3)** There were a number of areas where equipment provided for emergency response activities was either not suitable or not available.
- NCR 4)** Risk assessments for arrangements that rely on either one site supporting the other, or external bodies providing support in emergency situations, did not fully consider a scenario where this may not be possible.

4.0 Review Learn & Improve Assessment

4.1 The Director Stockpile Management (DSM) and Director Infrastructure (DI) commissioned a Review, Learn & Improve (RLI) by a cross-directorate team and agreed the Terms of Reference (ToR) for the RLI activities.



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A copy of the ToR is available at Annex A. The combined AE & RLI Team consisted of the following personnel.

[REDACTED]	DA	(Internal Regulation)	12(3)
	DA	(Environmental Advisor)	
	DSM	(Project Sponsors Representative)	
	DSM	(NITU Representative)	
	DI	(Emergency Management)	
	DMP	(Civil, Structural and Architectural)	
	DMP	(Civil, Structural and Architectural)	
	DBFM	(Business Continuity)	
	DA	(Safety Assessment)	
	DI	(Site Control)	

4.2 The key aim of the combined team was to ensure that all aspects of the extreme weather event were thoroughly examined so that lessons can be learnt in order to determine the appropriate level of preparedness required for any future events of this type and magnitude. Consequently, various themes emerged and company subject matter experts were engaged in providing a focus on their specialist subject.

5.0 Response and Recovery

5.1 AWE (A)

5.1.1 Response

5.1.1.1 The site emergency response teams (Fire & Rescue and Safety Shift) generally provided a well co-ordinated and effective first line response to the incident. The Fire & Rescue service quickly realised the scale of the event and requested support from the AWE (B) Fire & Rescue service and the Local Authority Fire & Rescue Service (LAFRS). The AWE (B) Fire & Rescue service were unable to provide assistance. Although busy the LAFRS did provide support from the Tadley Station (1 appliance), which successfully supported the site emergency services. The lack of sandbags during the incident was highlighted as an issue although it is not clear that additional sandbags would have mitigated any flooding to the site facilities that experienced water ingress. However, Site Control Operations has already addressed this issue on both sites through implementation of an interim contingency plan. The Site Utilities team reacted positively to the incident through implementation of their emergency procedures, which minimised any biological environmental impact, although one pump-house was flooded.



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Waste Management Group (WMG) also reacted quickly to the event by contacting the Environment Agency, managing the NPWMS effectively and operating the Storm Water By-Pass (SWBP) to prevent the NPWMS being overwhelmed. This was the first occasion where the SWBP has been called into service to manage excessive site surface water run-off since being commissioned. Overall the NPWMS and SWBP coped well, handling an incident that was estimated to be well above the facility's design intent.

5.1.1.2 It is clear that a site emergency was not formally declared although the Situations Control Centre (SCC) was activated with the duty Emergency Manager (EM) present. Consequently the incident strategic control was uncertain and facility managers would have no definitive instruction on the site status. As the site emergency response capability (excluding Health Physics) was already fully deployed, response to any further incident could have been severely delayed. The EM at the time of the event was unable to contact the site regulators and information exchange with Ministry of Defence (MoD) personnel was through site or mobile telephones. Use of the site secure communications system would not have resolved or improved such communications. However, [REDACTED] communication link to AWE (B) was not used for discussions with 12(5)(a) the Burghfield Emergency Controller (BEC), which possibly hampered the exchange of information between the sites.

Shift personnel provided assistance to residents in Aldermaston village and received a letter of thanks⁽⁴⁾ from one resident who believes the assistance provided significantly reduced the impact of the floodwaters on their property.

Recommendation 2

Site emergency management arrangements should be assessed to establish any training requirements and ensure that the site status is quickly and clearly communicated to all site personnel in any abnormal situation.

5.1.2 Recovery

5.1.2.1 The SCC closed down operations at 18.00 hours on Friday the 20th and recovery operations should have then commenced. However, Facility Managers (FM's), Leadership personnel, Key Service and Direct Suppliers were difficult to contact due to a lack of availability of up to date contact details. A number of FM's, through their own initiative, did attend site during the weekend (Saturday 21st / Sunday 22nd) to assess damage and attempt to commence recovery operations. However the lack of readily available resources (personnel / equipment / materials) restricted the effectiveness of such operations.



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5.1.2.2 The lack of a single dedicated focal point for co-ordinating weather / flood damage means that a comprehensive list of damaged or affected assets and equipment is not readily available, although the numbers of facilities effected was relatively small (Approx. 11). The key facilities affected were [REDACTED] and [REDACTED] (Medical Centre) where prompt action by the Fire & Rescue Services prevented any significant water ingress damage to the Medical Centre and kept the [REDACTED] operational. Due to the floodwater levels being controlled by the Fire & Rescue Services' response little in the way of clean-up operations was required in either facility and normal operational status was quickly regained.

Recommendation 3

Revise management arrangements to include a dedicated single point of contact for the reporting of damage during, and after, a site emergency situation.

5.2 AWE (B)

5.2.1 Response

5.2.1.1 The AWE (B) ground flooding event was significantly more severe than that experienced at the AWE (A) site, undoubtedly due to the site geographical location. The AWE (B) site suffered initial flooding during the storm ([REDACTED] & 10A Area's) followed some time later, after the rain had stopped, by an increase in water levels, which then surcharged the existing floodwater and consequently flooded the Assembly area buildings.

5.2.1.2 As with the AWE (A) event it is clear that a Site Emergency was not formally declared. The site emergency response teams (Fire & Rescue Service and Safety Shift) responded to calls for assistance with Shift fully occupied delivering and deploying sandbags to facilities thought to be at risk from flooding ([REDACTED] / 10A Area), while the Fire & Rescue Service deployed to [REDACTED]. The Shift team attempted to defend buildings, clear water and recover moveable assets from floor level in the 10A area, but were overcome by the volume of water. Shift personnel also provided assistance within the Assembly facilities during the second "phase" of the flooding incident.



[REDACTED]

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Fortunately three AWE (A) Shift personnel were at AWE (B) on an emergency response familiarisation tour at the time of the incident and supplemented the normal AWE (B) Shift complement throughout the response operations. The Fire & Rescue Service succeeded in keeping the [REDACTED] operational, although the facility 12(5)(a) did come close to being overwhelmed. Later the Fire & Rescue Service provided assistance in pumping water from the Assembly area and assisted neighbouring residents with de-watering operations.

Recommendation 2 Refers

5.2.2 Recovery

5.2.2.1 The recovery operation at AWE (B) appears to have been well organised and co-ordinated with the Site Control representative, Assembly, Explosives Group and Facility Management (FM) personnel all making positive contributions to the overall recovery effort. Recovery operations were prioritised and reviewed regularly, initially on a daily basis, to ensure appropriate resources were available or resourced and effectively deployed.

5.2.2.2 To deal with the Zone 4 flooding an Incident Command Centre was established to “make safe” through the implementation of the Burghfield Licensed Site Flood Recovery Plan⁽⁵⁾ and progress recovery operations to achieve a return to the normal operating structure. This initiative has worked well and steady progress is being achieved. The damage within Assembly area has been comprehensively catalogued and where appropriate is supported by photographic evidence, which should help in accurately assessing losses. Contract personnel who were involved in Assembly refurbishment projects have been re-assigned to assist in the Assembly remedial works.

5.2.2.3 It appears that stocks of Personal Protective Equipment (PPE) were insufficient to provide emergency responders and initial clean-up teams with readily available supplies of fit for purpose equipment (Gloves / clothes / wellingtons). In dealing with the aftermath of the flooding Shift personnel considered that the availability of suitable pumping equipment was insufficient, although flooding of this magnitude has never been previously experienced on the site.

Recommendation No. 4

***Assess the levels of equipment required to respond to a significant flood event.
Procure agreed stocks of equipment and implement suitable storage and
maintenance regimes.***



6.0 Information Management

6.1 Accurate information is a cornerstone of good management decision-making and action and can be Real-time, Historic or Predictive. Such information can be available in a variety of media types (Paper, Electronic, Photographic) as well as personal knowledge. The quality of the information is of key importance along with readily available access.

6.2 AWE (B) Security Cameras (Real-time)

Security camera footage of the affect of the 2007 flood event was obtained for parts of the site (Assembly & Southern Perimeter). Cameras ■, ■ and ■ recorded events at the ■ (around ■) while events within the assembly area were recorded by a number of cameras. The cameras could provide emergency response personnel (e.g. BEC) with valuable real-time site information in the ■ incident centre. However, the security cameras within the Assembly area are controlled from ■ and are not linked to ■, preventing emergency response personnel from viewing events within Assembly. The available recordings are dated / timed and confirm Assembly was affected approximately 2 hours after the initial flooding of ■ and 10A Areas had occurred. The AWE Media Imaging Group has produced an initial digital recording (DVD) from the available camera recordings. A number of still photographs are available of the AWE (B) 2000 flood event but are not uniquely identified, which can make it difficult to establish the exact location of the individual photograph content along with the time of recording.

Recommendation 5

All recorded data relating to significant AE's should be adequately identified at its time of capture, then controlled, stored and archived in accordance with company arrangements.

Recommendation 6

The requirement for a protective security classification for the recordings of AWE (B) security camera images (and DVD) requires to be established.



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6.3 Historical Data

6.3.1 AWE operates an Electronic Document Management System (EDMS – Documentum) to record and store electronic media. It is recognised that the system is outdated and searching for documents can be time consuming without yielding satisfactory results. This has been recognised in the Strategy For Information & Knowledge Management⁽⁶⁾ and an IT solution is being sought as part of the Information & Knowledge Management (IKM) project. A review of the EDMS produced the information for the “Previous Recorded Events” section of the report and valuable assistance was provided by the Company Action Tracking System (CATS) team in establishing the status of previous non-conformance reports. The quality of information included in previous non-conformance reports makes it difficult to establish, or confirm, the actual actions implemented.

Recommendation 7

The quality of information / data provided to record closure of actions should be checked for adequacy prior to the formal closure taking place.

6.3.2 The EDMS contains little useful data on AWE (B), however this could be due to the security classification restriction of the EDMS.

6.4 Health & Safety Files

6.4.1 During the RLI activities the Health & Safety File for the NPWMS was not readily available. The file would contain pertinent information on design and construction of the facility and should be retained, available and updated for the lifecycle of the facility (structure).

Recommendation 8

Locate the NPWMS Health & Safety File and ensure effective control of the data.

Recommendation 9

Carry out a company level review to establish the existence of Health & Safety Files for relevant projects, including storage and retrieval arrangements.



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7.0 Previous Recorded Flood Events

7.1 A review of the AWE AE database identified the following reports that registered significant previous incidents where excessive rainfall had affected AWE sites.

AE No. 022043 Dated 10/08/1999 – AWE (A)

The report noted that a storm on the previous day (09/08/1999) delivered 71mm of rainfall, which resulted in 10,000 m³ of un-sentenced water being released from the North Ponds (). The storage capacity available was reduced due to previous heavy rainfall and retention of water from an earlier weather event for treatment prior to discharge. 12(5)(a)

AE No. 045506 Dated 29/10/2000 – AWE (A)

The report noted that the North Ponds () water holding capability was in danger of being overwhelmed due to adverse weather conditions. On Monday 30th October surface water flows from the Centre Site were diverted away from the North Ponds Water Management Facility. This is contrary to normal operating procedure. (Centre Site surface water was diverted onto the North Ponds service road to discharge at the boundary fence). 12(5)(a)

AE No. 210868 Dated 30/10/2000 – AWE (B)

The report noted that due to abnormal weather conditions (Rain) several buildings on the Licensed Site were flooded. The summary report (AWE/SMA01/01/125/RH/1605) details severe flooding of the 10 A area in Zone 3 with some secondary flooding occurring in the plant rooms of buildings & in Zone 4. 12(5)(a)

7.2 All of the above AE investigation reports contain areas for improvement or further investigation. On review of the actions it is apparent that some progress has been achieved, ranging from “action complete” or “partial implementation” to “feasibility considered” and in some instances “no action implemented”. A subsequent investigative survey, completed by also contained recommendations. The initial proposal by was to undertake a full study that would have considered the river conditions both up and down stream of the AWE (B) site and provided proposed remedial works. However, a revised scope of work, approved by AWE, limited the actual study to the AWE (B) site boundaries. noted that to obtain approval from the EA to carry out remedial works on the brook a flood study extending beyond the site boundaries would be required. Again, the overall completion status of the recommendations is not clearly documented.



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The table at Annex B collates the corrective actions/recommendations raised from the AEs and [REDACTED] Report, and identifies the current status (Red, Amber, Green) as far as 12(5)(a) can be ascertained.

Recommendation No. 10

Determine the reasoning for non-completion of actions / recommendations including the appropriate authority involved in any decision making process and, where appropriate, instigate implementation of the original action.

8.0 Comparison of Events


8.1 The past recorded events of excessive rainfall (022043 AWE (A) 1999, 210868 AWE (B) 2000 & 045506 AWE(A) 2000) and the recent extreme weather 20th July 2007 can not be viewed in isolation from the 1989 storm which resulted in the migration of material beyond the site boundary and was the principal factor for AWE building the NPWMS, which was brought into service in 1999. The 1989 storm overwhelmed the original north ponds, releasing a deluge of site surface water run-off into the Aldermaston Court Lake and surrounding grounds (then owned by Blue Circle Plc). At the time of the 1989 event AWE was managed and operated by the MoD, although the site is now managed and operated through a Government Owned Contractor Operated (GOCO) agreement, which commenced in 1993. The original GOCO management team of Hunting Brae was replaced in 2000 when AWE ML was awarded the contract following a MoD competitive tender process.

8.2 A comparison of the events based on the available limited information is detailed at Annex C under each recorded event.

8.2.1 Facilities Affected

8.2.1.1 AWE (A)

In previous events on the site there is no record of any facilities being affected by floodwater except the NPMWS, which at the time had no SWBP and therefore excess surface run-off was diverted onto the service road to run freely to the site boundary. However during the 2007 event, when the SWBP was operational, 11 facilities were reported as experiencing water ingress due to flooding.

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8.2.1.2 AWE (B)

Available records indicate that 13 facilities experienced water ingress during the 2000 flooding, with very limited impact on the assembly area. However 84 facilities have been recorded as experiencing flooding in the 2007 event with approximately 40 of those within the assembly complex.

8.2.2 Affect on Capability

8.2.2.1 AWE (A)

None of the recorded events has had any significant impact on the site's operational capability. However the severity of the 2007 storm affected surrounding areas for a considerable distance and consequently made substantial demands on the Local Authority Emergency Services (LAES). With this in mind AWE management temporarily suspended High Hazard operations until the pressure on the LAES eased. The suspension of operations lasted only a few days although the site's emergency response capability was available at all times.

8.2.2.2 AWE (B)

Previous flooding on the site had no significant impact on the site's capability, with the majority of the buildings affected being "office / workshop type" facilities. However the 2007 event has affected virtually every facility on the LS causing widespread damage to infrastructure [REDACTED]. Additionally the [REDACTED], 10A area 12(5)(a) and Explosives area facilities were affected.

8.2.3 Affect on AWE's Reputation & Media Coverage

The event of 1989 received wide spread media coverage following a prosecution, which resulted in a substantial fine and costs. Media coverage of corporate prosecutions undoubtedly influences a corporate body's reputation. Since the GOCO contract arrangements came into force there has been little public interest in the sites in respect of previous flood events. There has been, to date, little public or media interest in the AWE sites resulting from the 2007 storm event.



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8.2.4 Estimated Costs

There was little meaningful financial information readily available to the RLI team but estimates of the 1989 event cost to the company is thought to be in the region of £16 Million (inclusive of Fines, Compensation and Capital spend on the NPWMS). There is no available cost for the impact on AWE (A) of the recent event but it likely to be very small in the overall picture. AWE (B) however is likely to incur considerable expense in regaining operational status, with the current spend estimated at [REDACTED]. 12(4)(d)

9.0 Surface Water Management

9.1 In general terms the surface water management arrangements for both AWE(A) and AWE(B) is principally to channel surface water run-off through dedicated water handling systems to approved out-falls on the sites boundaries.

9.2 AWE (A)

9.2.1 The AWE (A) site is predominantly flat and slightly elevated to the surrounding ground. As a consequence it does not receive, and therefore has no need to deal with, any surface water run-off from adjacent land. It is known that specific areas of the AWE (A) site have historic ground contamination and therefore an important part of the current surface water management policy is to contain surface water run-off from areas with known contamination issues for sampling and analysis prior to discharge off-site. The NPWMS complex was commissioned in 1999 and since then has processed surface water run-off, principally from the Nuclear Storage & Processing Area (NSPA) of the site that has known ground contamination and the Centre site area, which has no known ground contamination issues.

9.2.2 In 2003 an engineered Storm Water Bypass (SWBP) was commissioned which, during severe storm conditions, is utilised to divert surface water run-off collected from the Centre site area direct to the Aldermaston stream. This strategy provides the maximum storage capacity for surface water run-off with known contamination issues during severe storm events. A layout and schematic of the NPWMS is available at Annex D for information. During the storm conditions experienced on the 20th July 2007 the AWE (A) NPWMS and SWBP operated as designed.



Observations⁽⁸⁾ by personnel in attendance at the time would indicate that in the event of a similar weather event the SWBP should be brought into service immediately.

Recommendation No. 11

Put in place management arrangements to bring the SWBP on-line immediately in the event of AWE (A) receiving a similar weather forecast to that of the 20th July 2007.

- 9.2.3 The Aldermaston stream delivers all of the NPWMS (including the SWBP) discharge to the Aldermaston Manor Lake (Portland House). The Aldermaston Manor lake is managed by the Portland House landlord and has a weir that discharges into the Aldermaston stream. The management interface between AWE and the lake's landlord is clearly an important element of the surrounding area's water management strategy. AWE management appreciates the importance of the company's Corporate Social Responsibility and flooding of local surrounding areas is an area of considerable interest to the local communities. Transparent management arrangements with the Aldermaston Manor landlord in respect of surface water run-off is important in the control and discharge of water from the site and would demonstrate the AWE commitment to being a good neighbour.

Recommendation No. 12

Improve the interface arrangements between AWE and the Aldermaston lake's landlord and determine whether the lake could be used as a "buffer" for the site's surface water discharges during storm conditions.

Recommendation No. 13

The Aldermaston Local Liaison Committee (LLC) and Aldermaston residents should be invited to view the NPWMS to demonstrate the AWE commitment to improving surface water management in the area and controlling surface water run-off from the AWE (A) site.

- 9.2.4 The storm event on the 20th July caused localised ground water flooding on the AWE(A) site in a number of areas, with the following facilities affected : [REDACTED] (Medical Centre), 12(5)(a) [REDACTED], [REDACTED] (Process facility), [REDACTED] [REDACTED] (Stores), steam ducts and various low laying areas. Off site, Blacknest and Portland House also experienced some flooding.



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9.2.5 The AWE (A) Flood Map at Annex E identifies areas of localised flooding and Annex F provides a flood timeline depicting a chronology of issues arising from the flood event.

[REDACTED]

12(5)(e)

Recommendation No. 14

Install appropriate flood protection / water ingress arrangements for the [REDACTED] and [REDACTED] facilities.

Recommendation No. 15

Assess the consequences of [REDACTED] and [REDACTED] being identified a single point of failure.

9.2.7 A Utilities Strategic Plan was developed and issued in 2005 for AWE (A)⁽¹⁰⁾ during 2005. The Strategic Plan is under continuous development and is essentially “work in progress”. However, the Strategic Plan does identify deliverables that would enhance the site surface water management. Unfortunately, not all of the deliverables have been implemented with some having passed the scheduled target completion date.



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Table 1 below identifies the key deliverables and current status with more detailed information on the status of each deliverable shown at Annex G.

Deliverables	Target Date	Status
Impermeable Area Survey	Mar 06	Outstanding
Flow Survey	Jun 06	Outstanding
Manhole and Sewer Survey	Jun 06	Outstanding
Creation of Site Specific Rainfall Profiles	Mar 06	Underway
Computer Based Network Modelling	Jun 06	Outstanding
Hydraulic Analysis	Jun 06	Outstanding
Negotiations with the EA	On Going	Well Established
Determine SUDS Options	Jun 06	Individual Schemes Progressing Well
Land Drainage Legislation Review	?	Completed
Develop Policy on Flood Protection	Dec 06	Outstanding
Evaluation of Extreme/Catastrophic Events	Dec 06	Underway

Table 1: Key Deliverables


Recommendation No. 16

Taking into account this flood event, prioritise outstanding deliverables within the AWE (A) Utilities Strategic Plan for completion.

9.3 AWE (B)

9.3.1 Unlike AWE (A) site, the AWE (B) site is relatively low lying and is located within the flood plain of the river Kennet as shown on the EA flood maps, included at Annex J for information. The principal concern at AWE (B) is the risk of flooding from surface water run-off, particularly from the adjacent higher land.

9.3.2 The AWE (B) site has no historic ground contamination issues, which affect the discharge of surface water run-off from the site. The majority of the site surface water system drains to the Burghfield Brook on the south and west perimeter of the site. Monitoring of floodwater samples during the most recent flood event confirmed that all samples were below the level of regulatory interest in respect of RA and Biological content.

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9.3.3 The storm event on the 20th July caused severe ground water flooding on the AWE (B) site affecting the entire LS (Assembly), significant parts of A area, the [REDACTED] 12(5)(a) [REDACTED] and parts of the explosives area. [REDACTED]

[REDACTED] The AWE (B) Flood Map at Annex H identifies areas of localised flooding with Annex I providing a flood timeline depicting a chronology of issues arising from the flood event.

Recommendation 14 & 15 Refers

9.3.4 As the AWE (B) site closes down [REDACTED] the majority of 12(5)(a) [REDACTED] site staff had left site prior to the flood event taking full effect. Within the [REDACTED] [REDACTED] as the majority of [REDACTED] material had been removed from processing facilities and returned to [REDACTED] storage in accordance with Operating Procedures.

9.3.4 The clean-up and recovery of the AWE (B) site to a pre-flood status is well underway with prioritisation being given to recovery of buildings and assets that are essential to support operational capability. The AWE (B) LS has a flood recovery plan / programme in operation, which is progressing well and also identifies a number of issues where possible improvement against future events can be achieved.

9.3.5 A Utilities Strategic Plan was developed and issued for AWE (B)⁽¹¹⁾ during 2006. The Strategic Plan is under continuous development and is, as with the AWE (A) document, essentially “work in progress”. However, the document does identify deliverables that would enhance the surface water management on the site. The plan also details a conceptual flood barrier defence for the AWE (B) site and recommends further work through a series of deliverables. Unfortunately, not all of the deliverables have been implemented with some deliverables having passed the scheduled target completion date.



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Table 2 below identifies the key deliverables and current status with more detailed information on the status of the deliverables shown at Annex K.

Deliverables	Target Date	Status
Impermeable Area Survey	Sep 06	Outstanding
Flow Survey	Dec 06	Outstanding
Manhole and Sewer Survey	Dec 06	Outstanding
Creation of Site Specific Rainfall Profiles	Jul 06	Underway
Computer Based Network Modelling	Apr 07	Outstanding
Hydraulic Analysis	Apr 07	Outstanding
Negotiations with the EA	On Going	Well Established
Determine SUDS Options	Sep 06	Individual Schemes Progressing Well
Land Drainage Legislation Review	Dec 06	Completed
Develop Policy on Flood Protection	Dec 06	Outstanding
Detailed Study of the site Hydrogeology	Dec 06	Outstanding
Evaluation of Extreme / Catastrophic Events	Dec 06	Underway

Table 2: Key Deliverables

Recommendation No. 17

Taking into account this flood event, prioritise outstanding deliverables within the AWE (B) Utilities Strategic Plan for completion.

10.0 Emergency Management

10.1 It is clear that a Site Emergency was not declared and although both the EM (Emergency Manager - Aldermaston) and BEC (Burghfield Emergency Controller - Burghfield) played a significant role it was not clear that site personnel understood the site status and who was in charge. The EM and BEC kept an overview of the situation but it is not apparent that they took full control of the response required to manage the event. Further it is not clear that the current Site Emergency Plans^(12a & 12b) (both sites) cover flooding on the scale experienced during the event or if site exercises cover such an event.

Recommendation No. 18

Revise the Emergency Plans for both sites to adequately cover flooding on the scale experienced.



- 10.2 Although there was a lack of strategic direction, staff on both sites reacted as would be expected and prioritised their own actions to respond to what they believed were the immediate issues based on previous experience with flooding. Site staff, working in arduous and unpleasant conditions, should be commended for their response and actions on the day. Some of the issues noted during the 2007 event were highlighted following the AWE (B) flooding in 2000, although it now is apparent that the actions taken following the 2000 event were not fully effective in respect of flood protection measures for the AWE (B) site.

Recommendation 19

Revise the current emergency management arrangements for both AWE (A) and (B) to ensure emergency planning and response exercises include major non-nuclear events (e.g. large scale flooding) as well as nuclear scenarios.

The review should consider as a minimum:

Site Emergency Response Plans (Specifically for non-nuclear & off-site events)

Fall back centre(s) for key roles

Communications (External & Internal – Receive & Transmit)

Command & Control (Clear arrangements & sustainability)

Equipment & Welfare (Procurement, availability and suitability)

11.0 Business Continuity

- 11.1 Business Continuity (BC) is the process by which companies prepare for incidents that have the potential to severely affect their ability to conduct business. The fundamental objective is to ensure that any interruption is minimised with each affected business capability being restored within predefined time-scales. The Directorate Business Management & Finance (DBMF) is accountable for Corporate BC and for championing a consistent approach to BC throughout the business. Furthermore, all AWE Directorates have BC representatives that are suitably trained and where relevant Affiliates of the Business Continuity Institute.



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- 11.2 The AWE Quality Manual⁽¹³⁾ provides guidance as to the company framework for BC at AWE. Also a draft BC Crisis Plan⁽¹⁴⁾ that sets out, amongst other activities, the process for convening a team for the governance of business recovery underpins the BC policy. A template BC plan has been produced that will collate all information associated with recovering a business function including any specific work-rounds and recovery priorities, although an IT solution for retaining this information is still being sought.
- 11.3 The AWE Capabilities Database (ACD) has been identified as the cornerstone of the Directorate BC rollout as notionally, this aligns with the business functions / critical business processes that ensure AWE remains operational and as a company is able to meet the requirements of it's customer(s). All BC planning is focused upon the recovery of these business capabilities and in doing so, will highlight each of the principle components (e.g. facilities, equipment, resources, suppliers, people etc.) involved in undertaking these operations.
- 11.4 However, at present BC planning is in it's infancy at AWE and whilst a number of the principles have been applied BC could not have been relied upon at the time of the flooding. Currently no Directorate BC plans have been produced and only corporate level plans exist, covering IT, Telecoms, Crisis Management and Corporate Communication.
- 11.5 The BC community initiated an RLI⁽¹⁵⁾ to review the extant BC arrangements following the AWE (A) and AWE (B) 2007 flood event, which forms part of the overall RLI assessment. The purpose of this review was to recommend improvements to the existing arrangements that would enable efficient and effective responses to any future events of this magnitude. Specific areas of BC risk that suppress recovery and consequently require remedial action have been recognised and grouped under the headings detailed below with the complete listing available at Annex L.
- 1) Contact Lists
 - 2) MDP
 - 3) Communications
 - 4) Procurement
 - 5) Finance
 - 6) Telephony
 - 7) Governance
 - 8) Insurance

Recommendation No. 20

Deliver the rollout of Directorate BC plans to ensure suitable recovery arrangements are documented, resourced and exercised.



12.0 Risk Management

12.1 AWE has a corporate policy for risk management, which is implemented through the Risk Management Process and supported by a company procedure⁽¹⁶⁾. The Corporate Risk Team produced an AWE Corporate Risk Report on the Flooding at AWE (A) & (B)⁽¹⁷⁾ by interrogating the Corporate Risk Management System () and analysing ^{12(5)(a)} the available relevant risk data, which was downloaded on the 26th July. The data was obtained by completing a key word search of the system and the raw data then refined to extract relevant information.

12.2 The report concluded that;

- Generally risk reviews are not conducted frequently enough and there appears to be an over optimistic approach in respect of Risk Probability and Severity of Impact for both Pre and Post Mitigation assessments.
- The correct protocols in respect of manipulating data entries (Closed / Delete) are not being consistently followed.
- Key risks that relate to environmental issues require to be managed more coherently.

The report identifies a number of issues (Key Points) identified by the Corporate Risk Team review of the available data. The principal Key Points noted were;

- Lack of Fall Back Plans
- Lack of current control measures
- Lack of risk mitigation actions

12.3 A review of the risk register data included in the report identified a number of "Child" risk entries relating to flood events. However, these entries all related to discrete individual management areas with no overall "Parent" risk identified for flooding (surface water) of either the AWE (A) or AWE (B) sites. Clearly flooding is a foreseeable event that should be included in an appropriate risk register along with effective management actions.

Recommendation No. 21

An overarching "Parent" risk covering a "Flood event due to extreme weather conditions" should be added to a single register at the appropriate level for both AWE sites. The register should record the management actions necessary to mitigate and control the risk, including the measures / fall back plans to be implemented in the event of the risk occurring with the necessary link to emergency response and business continuity plans.



Recommendation No. 22

A further exercise is necessary to work with the relevant Risk Owners and Risk Managers of the risks identified to improve the quality of the risk data and the associated key Parent / Child relationships.

13.0 Safety Case & Safety Systems

13.1 Failure Modes

13.1.1 Although flooding may be caused by a variety of external events or potential plant failures, by far the most significant of these is direct flooding due to extreme rainfall and / or surface water run-off. Whether the frequency or severity of extreme weather events is changing as a result of global warming is still open for debate. Indeed, official sources of weather data have yet to take into account the impact of climate change by revising either return frequencies or rainfall quantities. CSP 865⁽¹⁸⁾ section 5 – Weather Data is to be reviewed at least annually in future in order to take account of any such changes.

13.2 Impacts of natural events on safety systems.

With respect to Criticality, the bulk of assessment effort goes into demonstrating one of two positions. Either that the flooding event will not affect the plant or process due to specific design features of the facility (walls, bunds, drains etc) or that in the event of a flood, criticality safety will not be degraded due to features of the process (safe by shape etc). Containment is also considered in safety cases, as is the sentencing and release of potentially contaminated waters as a result of an event, a good example of which is the purpose built NPWMS facility. The NPWMS processes surface water run-off from the current major RA facilities area. The reliability of services such as electrical supply to facilities should also be considered as some safety systems will not function without it. LC27⁽¹⁹⁾ assessments should consider this where necessary and identify where alternative Un-interruptible Power Supplies (UPS) should be provided. These are likely to be local to the facility and would in turn need to be protected from flooding.

Recommendation 23

Ensure that appropriate assessments have been completed, and documented, that consider the reliability of services to major RA facilities and that such assessments address flood risk.



- 13.3 All site development proposals must consider the location of proposed new RA facilities in respect of surface water run off, the collection of that run-off and possible effect on the existing NPWMS operational capability.

Site utilities such as electricity supply, telecommunications, drainage, gases etc are all susceptible to a flood event. Extant Safety Cases do not sufficiently assess the multiple failure of all services in this type of extreme event, suffice to say that operations would be suspended and facilities made safe under these circumstances.

However, more fundamental is the identification of demand and specific safety functional requirements (SFR) in respect of flooding withstand or abatement. The ability of flood to challenge safety systems in previously unexpected ways, e.g. door seals designed to contain a pneumatic load from within rather than a hydraulic load from without, is not well understood. Furthermore, post flood recovery actions must adequately reinstate the original Safety Systems and Components (SSC) through systematic testing and commissioning, thus re-proving its ability to deliver its design intent.

Recommendation 24

Commission a study to understand the ability of installed safety systems to withstand flood events and the levels of protection against water ingress to be expected.

Recommendation 25

Ensure that all original Safety Systems and Components (SSC) are thoroughly and systematically tested to ensure the design intent remains valid as part of the recovery and re-instatement activities.

- 13.4 Tolerable levels of risk

For both new build and existing facilities, the design basis natural event is that which would give rise to a worst case unmitigated radiological consequence to a member of the public of >100 mSv with a return period frequency of 10^{-4} . Therefore, less frequent and hence more severe events are beyond the design basis and not considered within the design. A further question of whether AWE may wish to consider natural events, specifically flooding, at lower frequencies based on the potential risk to our business is one that requires further consideration.

Recommendation 34 Refers



- 13.5 Identification and implementation of safeguards to achieve tolerable risk levels
- A systematic approach to identifying hazards, safeguards and mitigators is taken in all safety cases. A number of techniques are used the most common of which being Hazard and Operability Studies (HAZOP). Historically, the regulator has questioned the application of hazard identification techniques, although this picture is improving with progress of the programme for Periodic Review of Safety and revision of the hazard identification procedures. There remains the issue of how operability concerns that arise as result of HAZOP are considered in building design or remedial improvement action. It may be that current design standards for new build projects can be exceeded due to security or business drivers.
- Recommendation 26**
- Ensure that the existing AWE design process recognises, and implements the requirement to incorporate the output of any pertinent HAZOP studies into the proposed project design.*
- 13.6 Case for an AWE (B) Site Safety Case
- Safety cases exist for the Licensed Site, Boiler House, Group Explosives and some other minor facilities around the Site. However, any facility that can impact upon the Licensed Site should also be assessed, this assessment should also include the potential for flooding from areas adjacent to the LS. An AWE (B) Site Safety Case would have identified the potential for flooding as a potential interaction and therefore should have identified appropriate controls.
- Recommendation 27**
- Revise the Licensed Site Safety Case to review the interdependencies between the Licensed Site and remainder of the site, including off site potential hazards.*
- 13.7 Common mode failures between Sites
- There are shared services between the sites in respect to fire, ambulance, shift and health physics support. This being the case then “common mode” failures should be assessed. Extreme weather events such as flooding can affect both sites simultaneously, thus limiting each site’s ability to assist the other.
- Recommendation 28**
- Examine that existing emergency response capabilities on both sites address “common mode” failures.*



13.8 Facility safety cases consideration of natural external events

Natural external events are identified and assessed as part of routine safety case production. The particular set of circumstances surrounding the AWE (B) flood event could question the effectiveness of the process in the depth that the assessment goes to fully understand an external threat. Although the AWE (A) site as a whole sits on a plateau, local topography, the amount of hard-standing and landscaping will dictate the likelihood of flooding at the facility level. It is possible to assess in detail the potential causes of flood, i.e. modelling of the area surrounding a facility. However, it can be argued that effort is better spent proving that extreme events leading to worst case flood scenarios, where all systems could be compromised, are safe by design or that appropriate mitigative action can be taken in an acceptable timeframe.

13.9 Levels of withstand in new build projects and comparison with current practice.

Non-nuclear facilities are designed to provide a safe working environment for staff inside them by application of building standards. This is linked to the equivalent of a natural external event with a return period of not less than a 1 in 100-year event. However the recent flood event has been estimated to represent a return frequency of a 1 in 215-year event, thus posing the question of whether more severe natural external events should be considered within the design basis for a non-nuclear facility. For nuclear facilities the design criterion rises to a 10^{-4} return period, thus encompassing significantly more severe events than a 1 in 215-year return period. The design basis is concerned with the safety of plant / facilities to protect staff and other personnel (public) but does not necessarily take into account the business requirement to maintain operations or capability.

Recommendation No. 34 refers

14.0 Project Sponsorship

14.1 From a project sponsorship viewpoint, project delivery is divided into two principal areas, which can be defined as Project Definition (the right solution to the business need) and Project Delivery (provide the solution to time, budget and quality).



14.2 Project Definition

Definition of the right solution to the business need is a key aspect of project delivery. Consideration of the risk to the availability of that solution during its operational life is an important differentiator in option selection. Recent events indicate that water ingress to facilities can principally be from surface ground water flooding or seepage through saturated ground into structures below ground level. In extreme weather conditions the site foul waste system can be overcome and cause back-flow within the toilets of any facility, unless one-way valves were fitted in the foul waste system. Current new-build designs consider a 1 in 100-year return period event for non-nuclear facilities and a 1 in 10,000-year return period event for nuclear facilities. As the most recent flood event at AWE (B) is estimated at a 1 in 215-year return period event, it is obvious that the design considerations for non-nuclear facilities could be inadequate to prevent water ingress and damage, although current design considerations for nuclear facilities should be adequate. However, the design considerations should take into account all the utilities and infrastructure serving a high hazard category building and potentially the requirement for such facilities to be self supporting needs to be examined.

14.3 In light of recent weather events it is vital for future developments that the flood risk, particularly at AWE (B), is comprehensively considered and evaluated in terms of the impact of projected flood areas during severe weather events on proposed new development sites. Adequate consideration should also be given to any proposals for developments incorporating facilities that have assets, production or storage capability at, or below, ground level. It is apparent from recent events on AWE sites that guaranteeing water tightness long term may be a challenge and the need to plan for water ingress with the installation of pumping equipment as standard should be assessed. In some cases it may be necessary to rule out certain locations for future development or consider construction methods to build above ground level (piled platforms).

Recommendation 29

Re-assess the flood risk to new build projects if company design policy on flood risk is amended to a greater level (than mandated by current planning permission requirements) for non-nuclear facilities that support key operations.



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14.4 Project Delivery

The ability to deliver projects to time, budget and quality is essential to the achievement of Company and Customer milestones. The project spend profile is important to the Customer in respect of contract affordability issues. The impact of any event on a project is dependent on when the event happens within the project lifecycle. Generally, the earlier in the project lifecycle the event happens, the less the impact on the project programme and associated costs. The effect of the recent flood event is therefore assessed against the Pre-implementation and Implementation phases of a project. However, in either case contingency planning should consider immediate action required to alleviate damage should a repeat event occur.

14.4.1 Projects in Pre-Implementation Phases


For projects in the pre-implementation phases the potential impacts from a flood event are:

- Loss of work time due to evacuation / damage to work area
- Loss of key documentation due to water damage
- Increase to schedule and cost due to re-work resulting from a change to flood risk assumptions

Loss of key documentation should not be a major issue, due to electronic storage of information and good working practices in respect of document control. A simple preventive measure would be to ensure that all projects store equipment and documentation at a minimum height above floor level. Any loss of work time should be manageable with re-location or temporary accommodation easily procured. The major impact from an event will be in re-assessment of risks, costs, designs and facility locations in the light of a revised flood risk assumption, should it be forthcoming.

Recommendation No. 30

Revise project contingency plans to include preventative and immediate action in the event of a repeat event.

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14.4.2 Projects in Implementation

The major impacts of a flood event on projects in the implementation phase are:

- Programme delays due to exclusion from the work area (progress and schedule);
- Additional cost and programme impact to remediate damage to completed work;
- Delays due to clearance of new contract personnel following loss of original personnel due to forced inactivity;
- Delay and additional cost due to assessment of contractor damage claims and subsequent payment, where damage is increased by AWE's acts or omissions.
- Additional costs due to re-design and potential re-work due to a change in the design planning assumptions related to flood risk.

During the implementation phase of a project, the cost of delay is at its highest. Estimated costs for a current project under implementation within the assembly area are around £160K per month to maintain a non-productive project team. A decision could have been taken to lay off workers (contractors), which would appear to offer savings, but would maximise potential for the project to lose the services of DV cleared personnel, which in turn would increase the risk of delay to the project programme. In this particular instance the workforce has been re-assigned to assist in the Assembly remedial works.

14.4.3 DV cleared contract personnel are essential to the project and re-focussing the work scope in this way has advantages in providing a security cleared "clean up" work force, while ensuring such contract personnel are available when project work re-starts.

A similar event when construction, particularly at AWE (B), is at it's height would substantially increase the associated costs and the risk of loss of cleared staff. Mitigation could be provided through the use of construction enclave's utilising personnel with lower levels of security clearance. However, some projects (particularly Assembly area) would retain a higher risk due to the necessity to employ DV cleared labour. Again contingency planning should consider recovery measures to reduce delays to a minimum.

Recommendation No. 31

Project Sponsors / Project Managers should ensure that Project specific risk registers are reviewed in light of recent events and adequately address natural extreme events with meaningful and effective mitigation.



Recommendation No. 32

Project contractual arrangements should be reviewed with Procurement Group to ensure that adequate provision is included for events, such as flooding, in respect of liabilities for Contractor costs (time / equipment) including appropriate access for damage assessment. Project Sponsors / Project Managers should ensure that all contract arrangements include such provisions.

15.0 Civil Engineering & Design

15.1 AWE (A) Site

The localised flooding of the surface water drainage system was to be expected as the 2007 storm event (estimated at a 1 in 215-year event) exceeded the likely maximum design storm of 1 in 30-year. Other than this the existing surface water management systems and NPWMS coped with the volume of surface water runoff and the localised flooding that the site experienced dissipated fairly quickly.

15.2 AWE (B) Site

It appears that in extreme weather events the Burnthouse Bridge, at the brook outlet from the AWE (B) site, becomes a restriction for surface water runoff. The brook water level can only rise to the level of the underneath of the bridge before the brook begins to back up. The Burnthouse Bridge deck has a deep construction and therefore during extreme weather events the brook backs up considerably before overtopping of the bridge and associated roadway occurs.

There is an existing open culvert that runs through the assembly area, which reportedly follows the approximate route of the original brook alignment before the brook was diverted to its current course. In extreme events this culvert provides limited surface water storage. Removal of this culvert may discourage the surface run off from taking this route, but some limited storage would be lost.

15.3 Existing Surface Water Systems

The existing drainage systems for roads and buildings would have been designed to standards current at the time of construction and are likely to be capable of dealing with a 1 in 30-year event at most.



There are a number of Engineering measures that could be implemented to protect existing assets / facilities on both sites. However, before recommendations can be made suitable research to understand the full effects of a 1 in 100 year to 1 in 10,000 year storm on the current sites is required. Furthermore a corporate decision to establish those existing strategic assets / facilities that require increased flood protection is required. Increasing flood protection for commercial or operational reasons would need careful consideration, probably by a cost benefit analysis exercise.

- 15.4 If protection measures are implemented to prevent water ingress into selected areas / facilities it is inevitable that the flood water volumes will naturally relocate elsewhere and again a study of this impact should be carried out in association with any proposed protection scheme.

Recommendation No. 33

Commission a comprehensive flood modelling study to enable a full and accurate understanding of the effects on AWE sites and the adjacent land (catchment areas) for a selected range of return storm events. Such modelling should also examine the effects that any proposed localised flood protection measures (building / area specific) could have on the remainder of the site and review any off-site consequences.

Recommendation No. 34

Determine the appropriateness of current design requirements for facilities in respect of corporate risk from flooding associated with specific assets.

Recommendation No. 35

Ensure maintenance regimes for the existing surface water drainage systems, including the Burghfield Brook are adequate to maintain optimum system efficiency, including storage volumes.

- 15.5 Surface Water Drainage for New Projects

The current AWE Design Guide for any new development requires 1 in 100-year for non-nuclear facilities and 1 in 10,000 year for nuclear facilities. In addition the EA requires a further 20% capacity for surface water systems to account for climate change. All new projects are incorporating this requirement and this should be formalised in the AWE Design Guide.



The current AWE Design Guide standard for non-nuclear facilities is considered more than adequate to provide an acceptable surface water system, weighing risk of more extreme events against commercial cost of damage/further drainage provision. Further change to the guidance would need careful consideration of cost of protection measures against the likelihood of an extreme event and the cost associated with the likely damage. A 1 in 10,000-year storm is likely to have a devastating effect on the wider area and therefore as long as key facilities (nuclear) are kept safe, commercial viability following such a severe event becomes irrelevant. In order to understand the effect of a 1 in 10,000-year event a study should be carried out on both sites to include flood mapping and volumes.

Recommendation No. 33 Refers

15.6 Current surface water design is regulated on site to ensure that current systems do not take further runoff from the various new projects as they are developed. This is achieved by restricting surface water flow into the existing system by providing suitable surface water storage for each scheme.

15.7 Previous Events

There have been three recorded instances of excessive rainfall in the years prior to 20st July 2007. The 1989 storm event resulted in the NPWMS solution being built.

The event that occurred during August 1999 was estimated at between a 1 in 50-year and 1 in 75-year storm. The other event occurred during October 2000 and was estimated as 1 in 34-year storm. For a 1 in 34-year storm event a well maintained surface water drainage system should have been able to cope albeit with surcharged manholes.

These previous storms have given rise to the elevated AWE design guidance to design for a 1 in 100-year event. Current EA guidance and Planning Policy Statement 25 recommends that surface water drainage is designed to a 1 in 100 storm with a percentage allowance for climate change. AWE current design standards meets the recommended guidance and policy statement for non-nuclear design and for nuclear design significantly exceeds the recommended criteria.



16.0 Flood Protection Measures

Following the extreme weather event an immediate review of available flood mitigation measures was undertaken, which encompassed short, medium and longer-term solutions.

16.1 Short Term

16.1.1 Flood contingency plans were developed for both the both the AWE (A)⁽²⁰⁾ and AWE (B)⁽²¹⁾ sites that when implemented for future floods should help reduce damage to AWE assets and lessen the impact. Furthermore, 2000 sandbags were purchased and distributed (1000 each) between AWE (A) and AWE (B) sites. Emergency Flood Boxes have also been procured for both sites to store equipment and sundries (PPE, Mastic etc) for use in the event of flooding. The sandbags and emergency flood boxes will be stockpiled in areas adjacent to buildings assessed as being at risk from flooding.

Recommendation 36

Ensure the AWE (A) and AWE (B) Flood Contingency Plan's are regularly exercised.

16.1.2 In August 2007 a visual inspection of Burghfield Brook was carried out down stream of the Burnthouse Bridge⁽²²⁾ (beyond [REDACTED]) on land^{12(5)(a)} controlled by third parties. The inspection identified various issues that could cause a restriction to the Brook thereby reducing the flow rate off site, forcing the Brook to overtop and culverts to backup.

Recommendation 37

AWE (B) utilities FM to liaise with Third Parties (Land Owners) to encourage clearing of the Burghfield Brook in the immediate vicinity to the site.

16.2 Medium Term

16.2.1 AWE has investigated procuring a portable flood protection system that could be utilised as an intermediate flood defence solution. The [REDACTED] is easily^{12(5)(a)} erected, deployable by manpower and can also be installed as a permanent structure. A example of an installed section of [REDACTED] is provided at Annex M.

Recommendation 38

Investigate the available options that could provide a cost-effective medium term solution for local flood protection, pending any long-term resolution.



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16.2.2 AWE ground works contractor visited AWE (B) to ascertain the scope of work for de-silting and removing vegetation from the Brook and clearing of the Broad Street ditch and culverts.

Recommendation 39

Instruct the Ground Works contractor to begin clearing of Brook, Culverts and Broad Street Ditch prior to the on set of winter.

16.2.3 The below ground service penetrations for [REDACTED] and [REDACTED] have been identified as providing a pathway for floodwater ingress. ^{12(5)(a)}

Recommendation 40

An assessment of key facilities should be undertaken to establish the adequacy of existing measures to prevent water ingress damage from below ground service penetrations.

16.2.4 AWE has investigated procuring [REDACTED] a modern day alternative to the traditional sandbag. [REDACTED] can be stored easily (vacuum packed), are lightweight, have a shelf life of five years and are biodegradable. ^{12(5)(a)}

Recommendation 41

Procure corporate stock of alternative (floodbags) to traditional sandbags.

16.3 Long Term

16.3.1 Permanent long-term solutions can only be formulated on completion of the surface water run-off modelling and any subsequent design recommendations.

17.0 Lessons Learned

From the RLI assessment a number of lessons can be learned and these are identified below under appropriate headings.

17.1 Near Miss Events

Several key facilities (NPWMS / [REDACTED]) experienced Near Miss events during the storm event. Recommended engineering solutions and management planning should prove effective for any similar future event. ^{12(5)(a)}

17.2 Risk Management

The effectiveness of current risk management practices needs to be reviewed at all levels within the company to ensure that risks are identified, recorded and appropriately managed by meaningful mitigation measures and regular review. The risk management process should also encompass the possible business impacts of a risk occurring and include appropriate mitigation.



17.3 Safety Cases

It is apparent that existing safety cases consider in detail the possible nuclear effects that a hazard can produce and in doing so include assessments of the impact of natural external events. However, it is not clear to what depths such assessments go to fully understand the effects of extreme natural events and the totality of any impact on operations. Furthermore, it is not clear if adequate consideration is given to the failure of any non-nuclear facility / service on which the nuclear facility relies.

17.4 Information Management

The company's principal EDMS software is ageing and can be time consuming to search for relevant information, with no guarantee of success. It was also apparent that document control discipline within the company could be improved in respect of compliance with basic good document management practise and current company procedures. An improved IT solution has been sought for some time and a resolution of this issue may help improve document management.

17.5 Design (New Build)

The current design standards discriminate between nuclear and non-nuclear facilities and apply accepted design criteria in respect of the risk from flooding. AWE must consider if the "accepted design criteria" for non-nuclear facilities provides sufficient protection from a flood risk to meet the company's business objectives. Recent events would indicate that a corporate review of flood risk is required.

17.6 Corrective / Recommended Action Management

The management of corrective or recommended actions needs to be improved to ensure timely completion or re-prioritisation based on sound business and risk management judgement. The documented data for completed actions should give a full and meaningful description of the action taken.

17.7 Communications

The ability to contact personnel was highlighted as a problem area and, for AWE emergency contacts, has already been addressed. However efforts should be made to establish 24-hour contact availability with the site regulators and the MoD.

Recommendation 42

Review the adequacy of existing emergency contact arrangements between AWE, its Customer (MoD) and the site regulators.



18.0 Conclusions

18.1 The RLI assessment has examined a range of topics and has made 43 recommendations. The recommendations recognise the complexity of some of the issues and in these cases advise that further investigation is undertaken to determine an appropriate course of action. With the large amount of recommendations and the range of topics encompassed, it would be prudent to appoint a senior manager to ensure that all aspects are appropriately managed to a satisfactory conclusion and adequately documented.

Recommendation 43

A Senior Manager should be appointed to deliver an agreed programme of work addressing the recommendations raised in this RLI report.

18.2 The actions, and commitment, of all those involved in the initial response to, and the immediate recovery from the flooding deserves the highest praise, considering the difficult physical conditions.

18.3 The storm that occurred during July 2007 probably delivered the most intense rainfall in a few hours that the AWE sites have ever had to endure. Due to the AWE (A) site location the effects of the storm were essentially short-term on the facilities and operations with some localised flooding experienced. The NPWMS operated as expected but did come very close to being overwhelmed, which could have resulted in a release of potentially contaminated surface water run-off, similar to the event in 1989. Careful consideration must therefore be given to the possibility of a repeat weather occurrence and the manner in which AWE would manage such an event. A further area of concern during the event was maintaining the operational status of the site [REDACTED]. However, 12(5)(a) relatively basic civil remedial works to the building fabric and service penetrations should prevent any repeat during similar storm conditions.

18.4 The AWE (B) site has in the past experienced significant flooding to some areas of the site, without any great impact on the Assembly facilities. Therefore it is understandable that, based on previous experience, the Assembly facilities were not anticipated to be under any significant threat from the flooding, especially when the heavy rainfall had stopped and weather conditions were apparently improving. Subsequent recovery operations have been well organised with the site progressing towards regaining a normal operating structure.



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- 18.5 With the proposed development of the AWE site's capability to support the national defence strategy, probably the most important issue is the level of flood risk that can be tolerated for new non-nuclear facilities that support nuclear facilities to deliver the national and corporate objectives. This issue should be addressed quickly to minimise any impact to proposed projects from a possible amendment to flood risk design criteria and provide a long-term solution.
- 18.6 In the short to medium term an investigation should be completed to procure, and install, the most appropriate flood protection measures for key vulnerable assets. In particular an effective engineering solution to prevent water ingress through the building fabric and service penetrations for the [REDACTED] 12(5)(a), [REDACTED] should be addressed as a matter of urgency, given the strategic importance of these facilities to the [REDACTED] and [REDACTED].
- 18.7 There are a number of previous actions that are outstanding and completion of these issues along with the recommendations given in this report should provide measures (preventive and mitigation) to successfully manage a repeat storm event.
- 18.8 The RLI assessment has also highlighted a number of "business" issues not specifically related to flood, or storm, events. Some of these issues may take time to develop and implement, but should be pursued to bring the benefits that can be gained.
- 18.9 It should be noted that at no time during the storm event, resultant flooding or initial clean up was there any threat to the nuclear safety of either the AWE sites, the public or environment



19.0 Summary of Recommendations

Recommendation No. 1

Commission [REDACTED] to re-assess the event when official Meteorological Office 12(5)(a) information (rain gauge and radar data) becomes available and provide AWE with “official” assessment of the event.

Recommendation No. 2

Site emergency management arrangements should be assessed to establish any training requirements and ensure that the site status is quickly and clearly communicated to all site personnel in any abnormal situation.

Recommendation No. 3

Revise management arrangements to include a dedicated single point of contact for the reporting of damage during, and after, a site emergency situation.

Recommendation No. 4

Assess the levels of equipment required to respond to a significant flood event. Procure agreed stocks of equipment and implement suitable storage and maintenance regimes.

Recommendation No. 5

All recorded data relating to significant AE's should be adequately identified at its time of capture, then controlled, stored and archived in accordance with company arrangements.

Recommendation No. 6

The requirement for a protective security classification for the recordings of AWE (B) security camera images (and DVD) requires to be established.

Recommendation No. 7

The quality of information / data provided to record closure of actions should be checked for adequacy prior to the formal closure taking place.

Recommendation No. 8

Locate the NPWMS Health & Safety File (a legal requirement) and ensure effective control of the data.

Recommendation No. 9

Carry out a company level review to establish the existence of Health & Safety Files for relevant projects, including storage and retrieval arrangements.

Recommendation No. 10

Determine the reasoning for non-completion of actions / recommendations including the appropriate authority involved in any decision making process and, where appropriate, instigate implementation of the original action.



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Recommendation No. 11

Put in place management arrangements to bring the SWBP on-line immediately in the event of AWE (A) receiving a similar weather forecast to that of the 20th July 2007.

Recommendation No. 12

Improve the interface arrangements between AWE and the Aldermaston lake's landlord and determine whether the lake could be used as a "buffer" for the site's surface water discharges during storm conditions.

Recommendation No. 13

The Aldermaston Local Liaison Committee (LLC) and Aldermaston residents should be invited to view the NPWMS to demonstrate the AWE commitment to improving surface water management in the area and controlling surface water run-off from the AWE (A) site.

Recommendation No. 14

Install appropriate flood protection / water ingress arrangements for the [REDACTED] and [REDACTED] 12(5)(a) facilities.

Recommendation No. 15

Assess the consequences of [REDACTED] and [REDACTED] being identified a single point of failure.

Recommendation No. 16

Taking into account this flood event, prioritise outstanding deliverables within the AWE (A) Utilities Strategic Plan for completion.

Recommendation No. 17

Taking into account this flood event, prioritise outstanding deliverables within the AWE (B) Utilities Strategic Plan for completion.

Recommendation No. 18

Revise the Emergency Plans for both sites to adequately cover flooding on the scale experienced.

Recommendation No. 19

Revise the current emergency management arrangements for both AWE (A) and (B) to ensure emergency planning and response exercises include major non-nuclear events (e.g. large scale flooding) as well as nuclear scenarios.

The review should consider as a minimum:

- Site Emergency Response Plans (Specifically for non-nuclear & off-site events)
- Fall back centre(s) for key roles
- Communications (External & Internal – Receive & Transmit)
- Command & Control (Clear arrangements & sustainability)
- Equipment & Welfare (Procurement, availability and suitability)



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Recommendation No. 20

Deliver the rollout of Directorate BC plans to ensure suitable recovery arrangements are documented, resourced and exercised.

Recommendation No. 21

An overarching "Parent" risk covering a "Flood event due to extreme weather conditions" should be added to a single register at the appropriate level for both AWE sites. The register should record the management actions necessary to mitigate and control the risk, including the measures / fall back plans to be implemented in the event of the risk occurring with the necessary link to emergency response and business continuity plans.

Recommendation No. 22

A further exercise is necessary to work with the relevant Risk Owners and Risk Managers of the risks identified to improve the quality of the risk data and the associated key Parent / Child relationships.

Recommendation No. 23

Ensure that appropriate assessments have been completed, and documented, that consider the reliability of services to major RA facilities and that such assessments address flood risk.

Recommendation No. 24

Commission a study to understand the ability of installed safety systems to withstand flood events and the levels of protection against water ingress to be expected.

Recommendation No. 25

Ensure that all original Safety Systems and Components (SSC) are thoroughly and systematically tested to ensure the design intent remains valid as part of the recovery and re-instatement activities.

Recommendation No. 26

Ensure that the existing AWE design process recognises, and implements the requirement to incorporate the output of any pertinent HAZOP studies into the proposed project design.

Recommendation No. 27

Revise the Licensed Site Safety Case to review the interdependencies between the Licensed Site and remainder of the site, including off site potential hazards.

Recommendation No. 28

Examine that existing emergency response capabilities on both sites address "common mode" failures.



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Recommendation No. 29

Re-assess the flood risk to new build projects if company design policy on flood risk is amended to a greater level (than mandated by current planning permission requirements) for non-nuclear facilities that support key operations.

Recommendation No. 30

Revise project contingency plans to include preventative and immediate action in the event of a repeat event.

Recommendation No. 31

Project Sponsors / Project Managers should ensure that Project specific risk registers are reviewed in light of recent events and adequately address natural extreme events with meaningful and effective mitigation.

Recommendation No. 32

Project contractual arrangements should be reviewed with Procurement Group to ensure that adequate provision is included for events, such as flooding, in respect of liabilities for Contractor costs (time / equipment) including appropriate access for damage assessment. Project Sponsors / Project Managers should ensure that all contract arrangements include such provisions.

Recommendation No. 33

Commission a comprehensive flood modelling study to enable a full and accurate understanding of the effects on AWE sites and the adjacent land (catchment areas) for a selected range of return storm events. Such modelling should also examine the effects that any proposed localised flood protection measures (building / area specific) could have on the remainder of the site and review any off-site consequences.

Recommendation No. 34

Determine the appropriateness of current design requirements for facilities in respect of corporate risk from flooding associated with specific assets.

Recommendation No. 35

Ensure maintenance regimes for the existing surface water drainage systems, including the Burghfield Brook are adequate to maintain optimum system efficiency, including storage volumes.

Recommendation No. 36

Ensure the AWE (A) and AWE (B) Flood Contingency Plan's are regularly exercised.

Recommendation No. 37

AWE (B) utilities FM to liaise with Third Parties (landowners) to encourage clearing of the Burghfield Brook in the immediate vicinity to the site.



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Recommendation No. 38

Investigate the available options that could provide a cost-effective medium term solution for local flood protection, pending any long-term resolution.

Recommendation No. 39

Instruct the Ground Works contractor to begin clearing of Brook, Culverts and Broad Street Ditch prior to the on set of winter.

Recommendation No. 40

An assessment of key facilities should be undertaken to establish the adequacy of existing measures to prevent water ingress damage from below ground service penetrations.

Recommendation No. 41

Procure corporate stock of alternative (floodbags) to traditional sandbags.

Recommendation No. 42

Review the adequacy of existing emergency contact arrangements between AWE, its Customer (MoD) and the site regulators.

Recommendation No. 43

A Senior Manager should be appointed to deliver an agreed programme of work addressing the recommendations raised in this RLI report.



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20 References

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Annex A RLI Group Terms of Reference

1. Background

On the 20th July 2007 prolonged and torrential rainfall in the vicinity of both AWE (A) and AWE(B) sites resulted in some areas of the sites and its infrastructure (facilities, utilities, plant and equipment) being subjected to severe flooding. This flooding was particularly evident at AWE (B)

2. Requirement

This event has prompted the AWE Executive Board to commission a multidiscipline, cross directorate team to conduct an investigation into the impact that this extreme weather event had on the AWE (A) and AWE (B) sites.

3. Objective

The objective of this investigation is to assess the impact of the flooding as well as the response to this event by conducting a Review, Learn and Improve (RLI) assessment. Historical events will be considered in order to determine what mitigation was identified following these events and an assessment will be made of how effective the mitigation was. The output from the investigation will be communicated to AWE Management Ltd, the AWE Executive Board, the NWIPT and regulatory bodies. The report will be concluded by the 30th September 2007.

4. Terms of Reference

The primary function of the ToR set out below is to ensure that all aspects of the extreme weather event are thoroughly examined so that lessons can be learnt in order to determine the appropriate level of safeguarding and mitigation for any future events of this type and magnitude.

- Set up a multidiscipline cross directorate team
- Define priority themes for investigation focus
- Assess the consequences of the extreme weather event for the company
- Review the initial actions and immediate response to mitigate the consequences
- Examine the company's preparedness for such an extreme weather event
- Identify any 'near miss' issues with potentially significant consequences
- Identify any appropriate areas for improvement including any implications for future site wide solutions and facility design
- Identify areas warranting further investigation
- Identify lessons learnt
- Make recommendations
- Provide a report in timescale agreed with the convening authority

5. Investigation Team & RLI Core Members

The multidiscipline, cross directorate team is accountable to the Deputy Managing Director and Director Infrastructure for delivery of the RLI assessment. The team will also be responsible for presenting their findings to key stakeholders.



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Annex B Overview of AE Action Status

Recommendation/Non-conformance		Status
SRI 022043 (10/08/99) AWE (A)		
1	DSD/FM to compile an information pack for the duty Emergency Manager to assist in the "forward-looking" decision making process.	<p>Action Complete Information pack was compiled at the time and recently a North Ponds Aide Memoire has been produced (EDMS1/800D91C9/B/WMG/W4200).</p>
2	<ol style="list-style-type: none"> 1) Provision of an engineered storm bypass 2) Assess the suitability of the level probe and "high-high" alarm. 3) Test the failure mode for the remote actuation valves on removal of power and reinstatement of the supply. 4) Review the need for a land-line telephone link to the shift control room. 5) Review the layout and construction of the local control room to ensure essential control systems are protected from water ingress. <p>DSD/FM to ensure the above points are included on the improvement plan for the North Ponds water management system and to present the plan to the NSC as part of the safety case resubmission.</p>	<p>1) Action Complete Engineered storm bypass commissioned in 2003 and operated as designed during the 20th July 2007 storm.</p> <p>2) Action Complete Suitability of the level probe and "high-high" alarm was investigated and sealed against water ingress.</p> <p>3) Action Complete Failure mode for the remote actuation valves on removal of power and reinstatement of the power supply was tested and operated as designed.</p> <p>4) Action Complete █ land-line telephone installed.</p> <p>5) Action Complete Cable ducts sealed to prevent water ingress.</p>

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Annex B (continued) Overview of AE Action Status

Recommendation/Non-conformance		Status
SRI 022043 (10/08/99) AWE (A) Continued		
3	DSD/Shift to ensure two-way radios be made available to the Emergency Manager and Assurance Manager in the event of an incident at the north ponds water management system. (Interim measure while land-lines are installed).	Action Complete land-line telephone installed
4	Dtech/MCBA to investigate availability of online gross α and β monitoring technology to analyse within the consented and draw up a development programme.	Feasibility considered No viable technical options were identified. The main difficulty is reaching the very low detection limits required (and currently achieved by a 12 hour count in the laboratory).
SRI 045506 (29/10/00) AWE(A)		
1	Copy of formal qualitative discharge consent could not be found	Action Complete Discharge consents located
2	Inability to contact appropriate expert personnel or their deputies at all times.	Action Complete A system has been implemented to ensure the Duty On-Call Manager can be contacted.
3	Temporary operational arrangements, when in place, should have supporting documentation setting out circumstances wherein the temporary arrangements can or should be overridden.	Action Complete Where required temporary operating instructions are produced.

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Annex B (continued) Overview of AE Action Status

Recommendation/Non-conformance		Status
SRI 045506 (29/10/00) AWE (A) Continued		
4	Operating procedures to be reviewed so as to ensure that the available storage is maximised at all times.	Action Complete Operating procedures were reviewed and the North Ponds Aide Memoire (EDMS1/800D91C9/B/WMGW4200) calls for discharging at the earliest opportunity to keep the capacity of the North Ponds maximised.
5	Discharge authorisation limits to be reviewed for both shift personnel and North Ponds facility management. Suggested revised limits 50Bq/m3 and 75Bq/m3 respectively.	Action Complete Discharge limits reviewed and clearly defined for Duty Shift Manager, Duty On-Call Manager and HoE.
6	Networked computer facilities to be installed in EMG laboratories to enable 'count' results to be read directly at the shift control room.	Partial Implementation The counter computers in [redacted] were subsequently connected to the AWE [redacted] network. Enquiries were made - but it seems there is no simple way of making the live display readable remotely. It is possible that this could be achieved using modern wireless telemetry. But this could not be done via the site [redacted] network and a dedicated standalone solution would be required. A development project will be needed - in conjunction with IT BS - and resource in that area has been very scarce in recent times.

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Annex B (continued) Overview of AE Action Status

Recommendation/Non-conformance		Status
SRI 045506 (29/10/00) AWE (A) Continued		
7	Liquid scintillation analysis to be investigated as a possible method for reducing sentencing times.	<p>Feasibility Considered This was investigated via a contract with [REDACTED]. The method will not yield improved count times. However it is possible that new methods might lead to more rapid sentencing - if alternatives to gross alpha activity could be developed. This would be a medium term R&D project.</p>
8	Construct and verify real time mathematical model of the North Ponds facility and use this model, together with the hydro works catchment model currently being built, to simulate a whole range of rainfall events and operating scenarios. Use the results to determine the optimum operating arrangements.	<p>No Action Implemented No action implemented at the time due to lack of resources and funding constraints. However this was to be included in the utilities strategy for 2001 – 2002.</p>
9	Establish if any external notifications/authorisations are required if we were to change our method of operation of the North Ponds facility.	<p>Action Complete External approval would be required by the EA as this is an authorised outfall.</p>
10	Arrangements to put in place with the Met Office such that during an event an open dialogue can be created wherein more precise and up to date information can be called for at short notice, e.g. immediately prior to making a decision to close valve [REDACTED]	<p>Action Complete Contract in place</p>

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Annex B (continued) Overview of AE Action Status

AE 210868 (30/10/00) AWE(B)

1	West Berkshire County Council Highways Department be approached to determine if alteration can be made to the road culvert to increase its flow capacity. It is also recommended that the stretch of Burghfield Brook downstream of the site is dredged and that the vegetation within the watercourse is removed and overhanging trees pruned.	Status Unknown
2	The lower watercourse of the Burghfield Brook on site should be dredged in the spring of 2001 and consideration given to the use of existing sluice gates to control the flow in times of abnormally heavy continuous rain.	No Action Implemented
3	As a short term engineering solution to the high volume of water passing through the sewage plant, it is recommended that the wall height surrounding the holding tanks and valve pit be raised and that the discharge arms to the filter beds be modified to give a greater water flow rate.	Partial Implementation Only the discharge arms have been modified.
4	Long term, the introduction of other services, such as rainwater down pipes and boiler house water waste, to the foul drainage system need to be reviewed together with the capping of all drain outlets from demolished buildings.	Partial Implementation Capping of all drain outlets is being done as buildings are demolished.



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Annex B (continued) Overview of AE Action Status

	Recommendation's	Status
AWE Burghfield Flood Study ([REDACTED] - March 2002 Rev. 1)		
1	Recommend consultation with the Environment Agency over river management.	Status Unknown
2	Investigation and stabilisation of channel banks	Partial Implementation Burghfield brook has had some work carried out on the channel banks within the past couple of years. The AWE(B) utilities [REDACTED] is currently in the process of engaging a consultant to survey remainder of brook channel banks.
3	Investigation of the extent of offsite influences, Broad Street Ditch including connecting pipes and down stream of Burnthouse Bridge.	No Action Implemented Waiting for costing's from AWE ground works contractor for clearing Broad Street Ditch and down stream of Burnthouse Bridge. Survey of connecting pipes from Broad Street Ditch is intended for the near future.
4	Investigation and possible rationalisation of existing channel structures	No Action Implemented Currently a review of culverts is proposed.
5	Clearing of vegetation	Partial Implementation Repeated contractual problems in clearing vegetation from brook banks and channel.

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Annex C Extreme Weather Event Comparison Table

Event	AWE(A) 1989	AWE(A) 1999	AWE(A) 2000	AWE(A) 2007	AWE(B) 2000	AWE(B) 2007
Buildings Affected	North Ponds / Off-Site	North Ponds / Off-site No site Facilities Recorded	North Ponds / Off-site No site Facilities Recorded	11 Buildings	13 Buildings	84 Buildings
Capability Affected	No	No	No	Controlled Effect ^(a)	Very Slight ^(b)	Severe Disruption ^(c)
Reputation Affected	Yes	N/A	No Record	No	Slightly	Yes
Media Coverage	Substantial	N/A	Yes	Yes	Some	Very Limited
Estimated Costs	██████████	Not Known	Construct Storm Water By-pass – ██████████	Not Known	Not Known	██████████

12(4)(d)

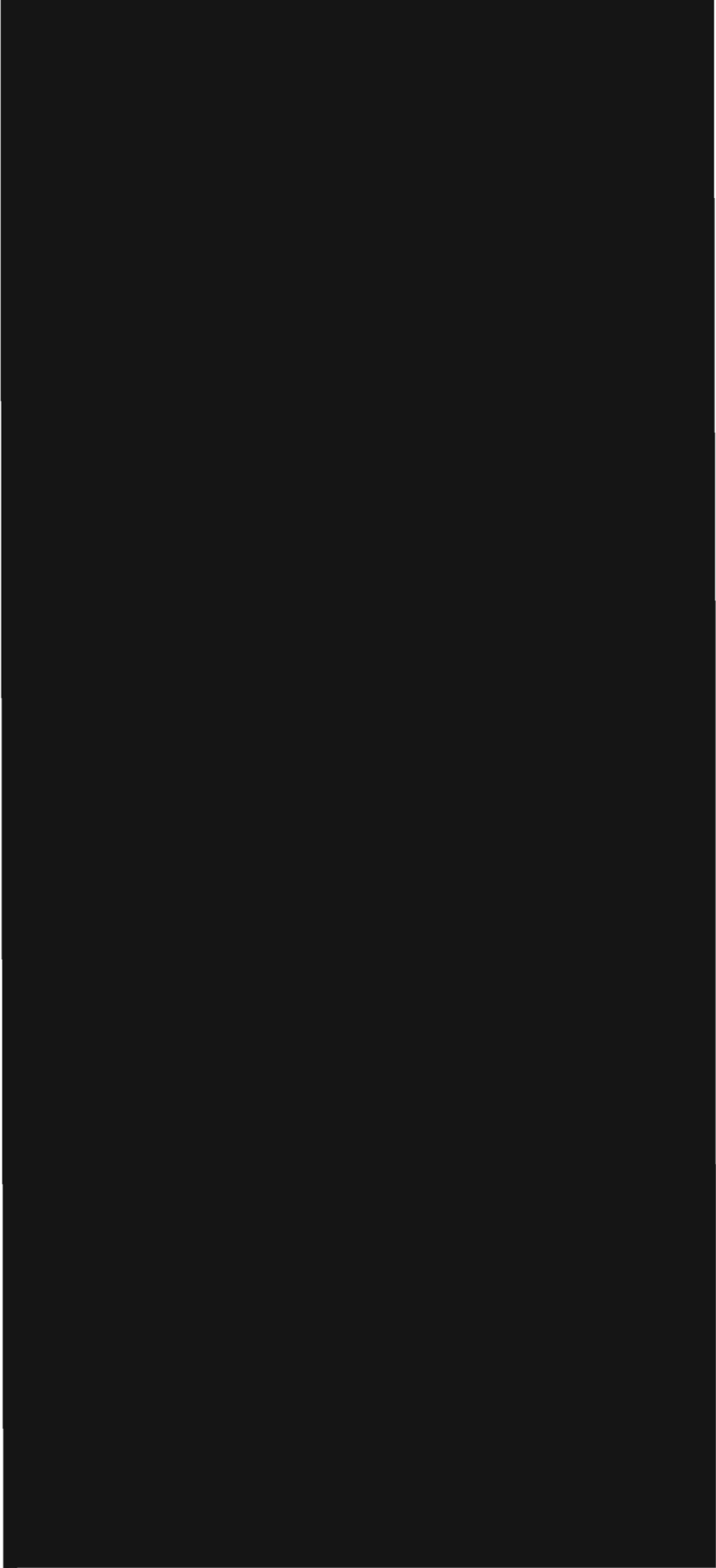
- (a) The AWE (A) site suspended High Hazard operations for a short time due to widespread flooding and the pressure this placed on Local Authority Emergency Services, however capability was available at all times.
- (b) The AWE (B) experienced flooding mainly to facilities outside of the Licensed Site.
- (c) Virtually every facility within the Licensed Site experienced floodwater ingress with varying degrees of damage resulting.



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Annex D Layout of North Ponds Water Management System

12(5)(a)



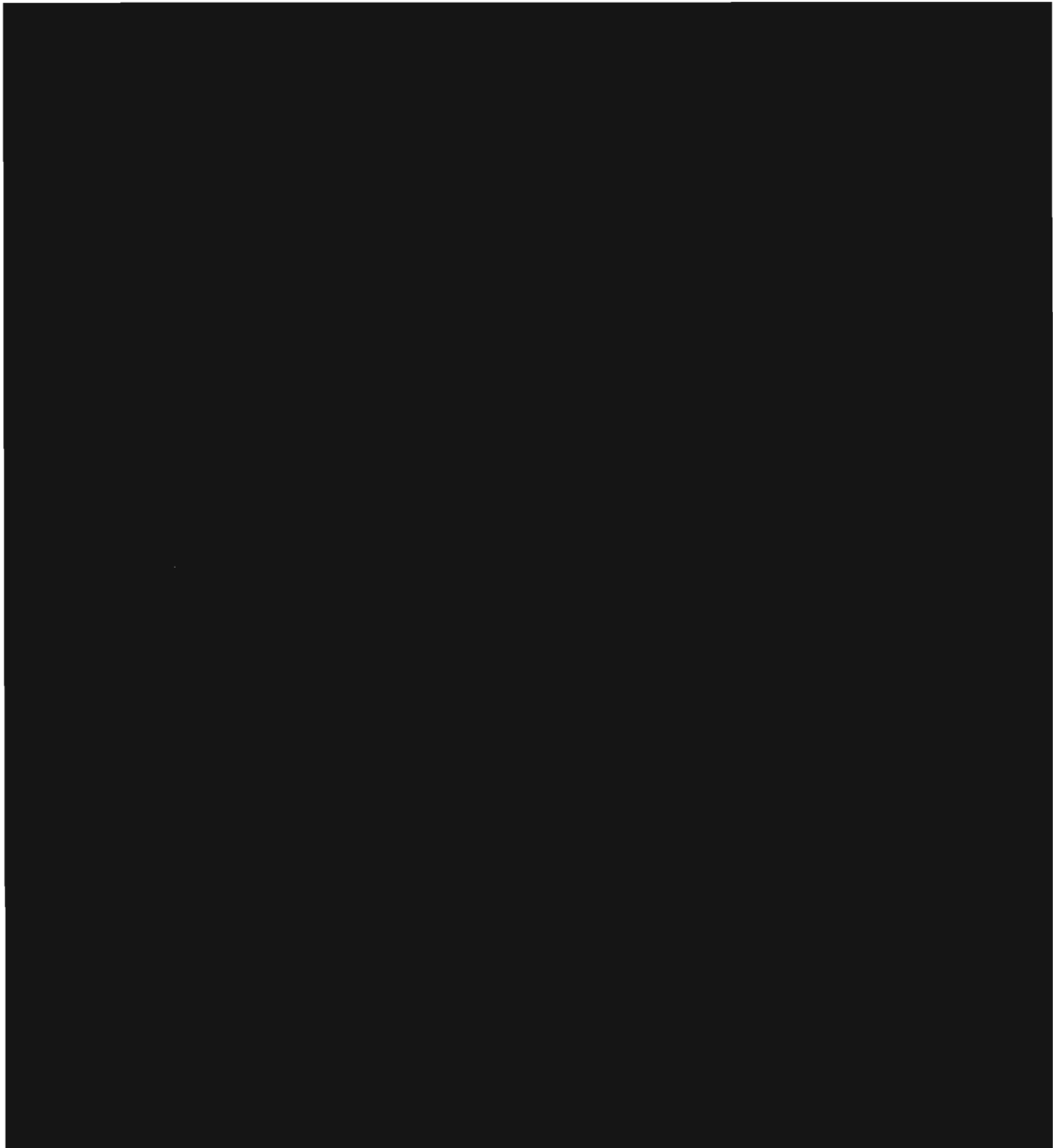


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Annex D North Ponds - Schematic for Entire System

12(5)(a)





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Annex E Aldermaston Flood Map

AW&E Aldermaston - 20th July 2007 Proposed Flood Extent.

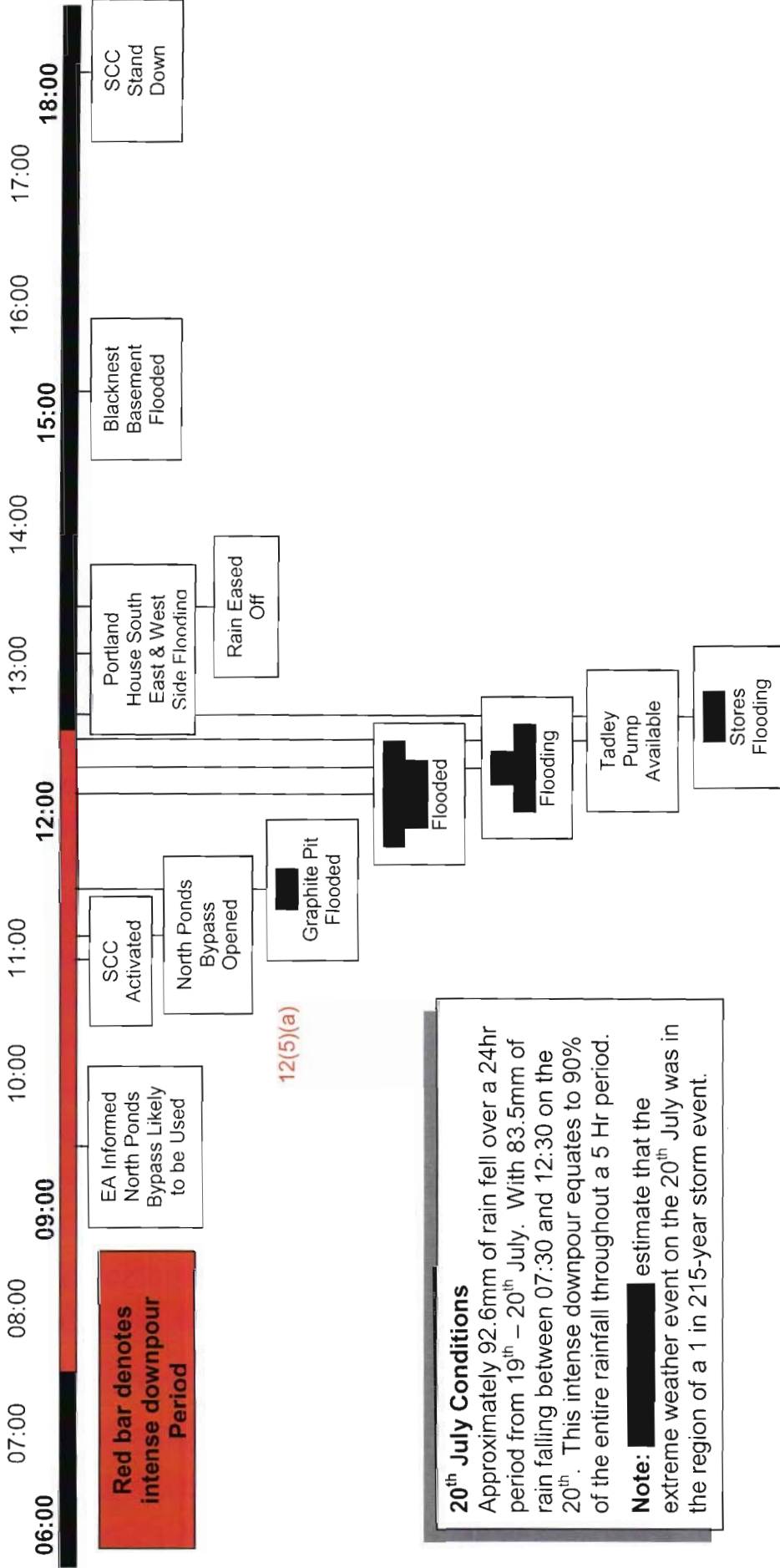




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Annex F Friday 20th July 2007 Flood Timeline AWE (A)



20th July Conditions

Approximately 92.6mm of rain fell over a 24hr period from 19th – 20th July. With 83.5mm of rain falling between 07:30 and 12:30 on the 20th. This intense downpour equates to 90% of the entire rainfall throughout a 5 Hr period.

Note: [Redacted] estimate that the extreme weather event on the 20th July was in the region of a 1 in 215-year storm event.

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Annex G Information Summary of AWE (A) Utilities Strategic Plan Key Deliverables

Deliverables	Target Date	Status
Impermeable Area Survey	Mar 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Flow Survey	Jun 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Manhole and Sewer Survey	Jun 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Creation of Site Specific Rainfall Profiles	Mar 06	This is underway but has been impacted by funding-related issues. This is a UHED-managed activity being undertaken by [REDACTED].
Computer Based Network Modelling	Jun 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Hydraulic Analysis	Jun 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Negotiations with the Environment Agency	On Going	Deliverable outstanding. AWE and the EA have well-established, successful negotiations on AWE Surface Water Drainage/SUDS issues. Key AWE team members are [REDACTED].
Determine SUDS Options	Jun 06	Currently SUDS options are being addressed by the individual Schemes. In order to establish a unified, efficient, economic approach to the design and Planning Submissions of SUDS, a specialist design house is being considered to be appointed to provide corporate solutions. Surface water drainage is a critical aspect of AWE Planning Submissions and receives heavy scrutiny. This is a UHED/Sites Development-managed activity being undertaken by [REDACTED], and is sponsored by DI. Progressing well.
Land Drainage Legislation Review		Deliverable completed. This is a UHED-managed activity being undertaken by [REDACTED].

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Annex G (continued) Information Summary of AWE (A) Utilities Strategic Plan Key Deliverables

Deliverables	Target Date	Status
Develop Policy on Flood Protection	Dec 06	Deliverable outstanding. The Utilities Steering Group was established to address this type of corporate risk issue (). Current status unknown.
Evaluation of Extreme/Catastrophic Events	Dec 06	This is underway but has been impacted by funding-related issues. This is a UHED-managed activity being undertaken by .

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Funding Notes

Utilities & Highways Engineering Dept (UHED) was funded to carry out this activity under the DI PIR-approved Business Case 'AWE Utilities Engineering FY05-06 to FY07-08 NWCSP – AWE Utilities' Doc Ref EDMS1/800B61F1/B/ES1300. This was approved by DI PIR in 2005.

In 2006, funding for the water supply and waste water drainage activities was transferred from UHED by the Project Sponsor with the intention of tasking with these activities.

were seen at that time as having the potential to provide a unified supply of all utilities services, and was obviously in keeping with Procurement Dept's drive to streamline the supply chain by rationalising the number of suppliers.

UHED recently has had funding provisionally restored and has been instructed to resurrect the original programme activities.

The progress and financial status of the DI PIR-approved Business Case 'AWE Utilities Engineering FY05-06 to FY07-08 NWCSP – AWE Utilities' will be presented to PIR imminently (provisionally scheduled for 2 Oct 2007).

Management Notes

UHED is an operational area of DI Engineering Services (DI / ES)

UHED primarily provide specialist-engineering services to Site Utilities, via the for Utilities and the for Roads & Grounds.

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The current Project Sponsor for UHED services is , DI Project Sponsor (Utilities). 12(3)



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Annex H Burghfield Flood Map

AW&E Burghfield - 20th July 2007 Proposed Flood Extent.

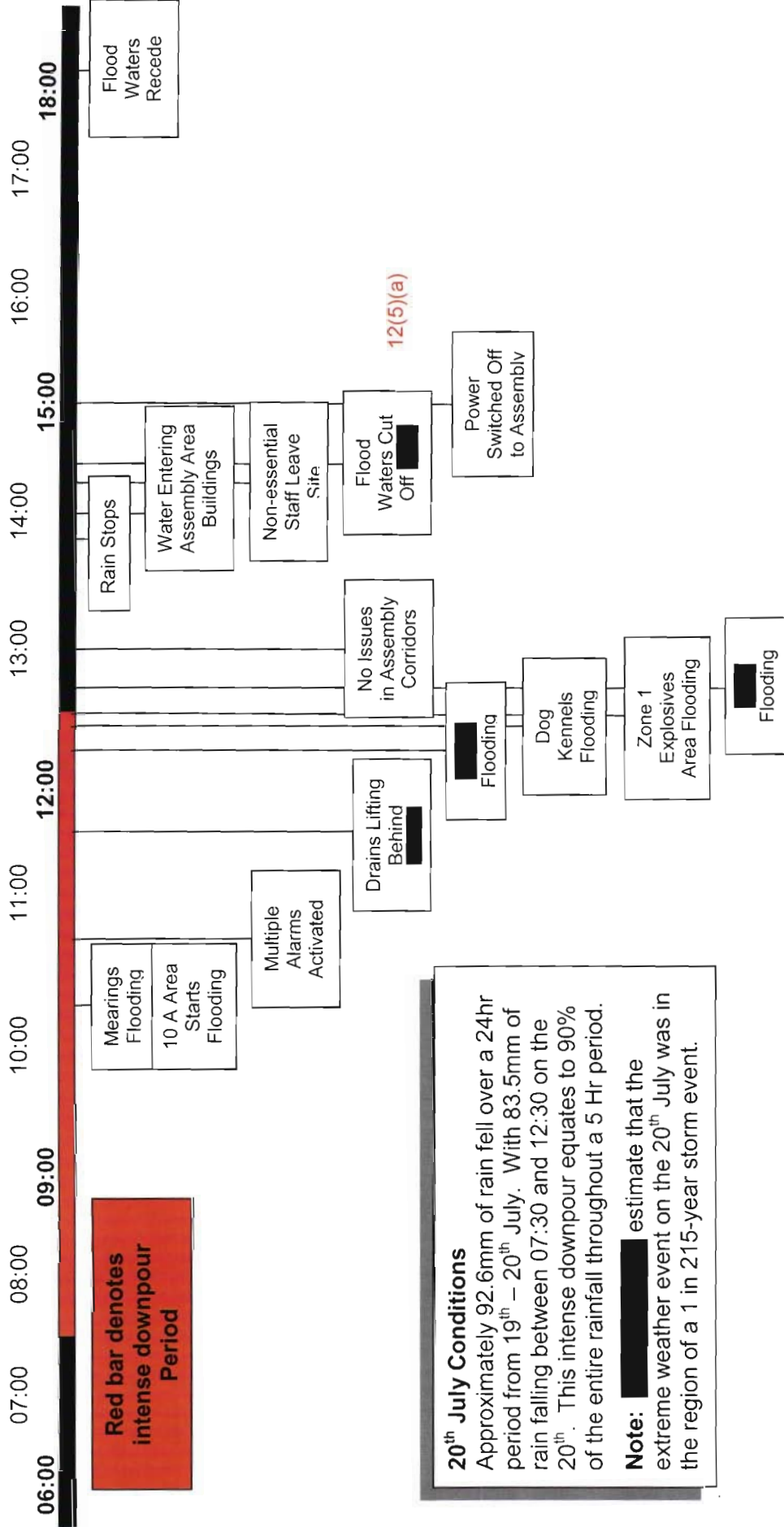




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Annex I Friday 20th July 2007 Flood Timeline AWE (B)

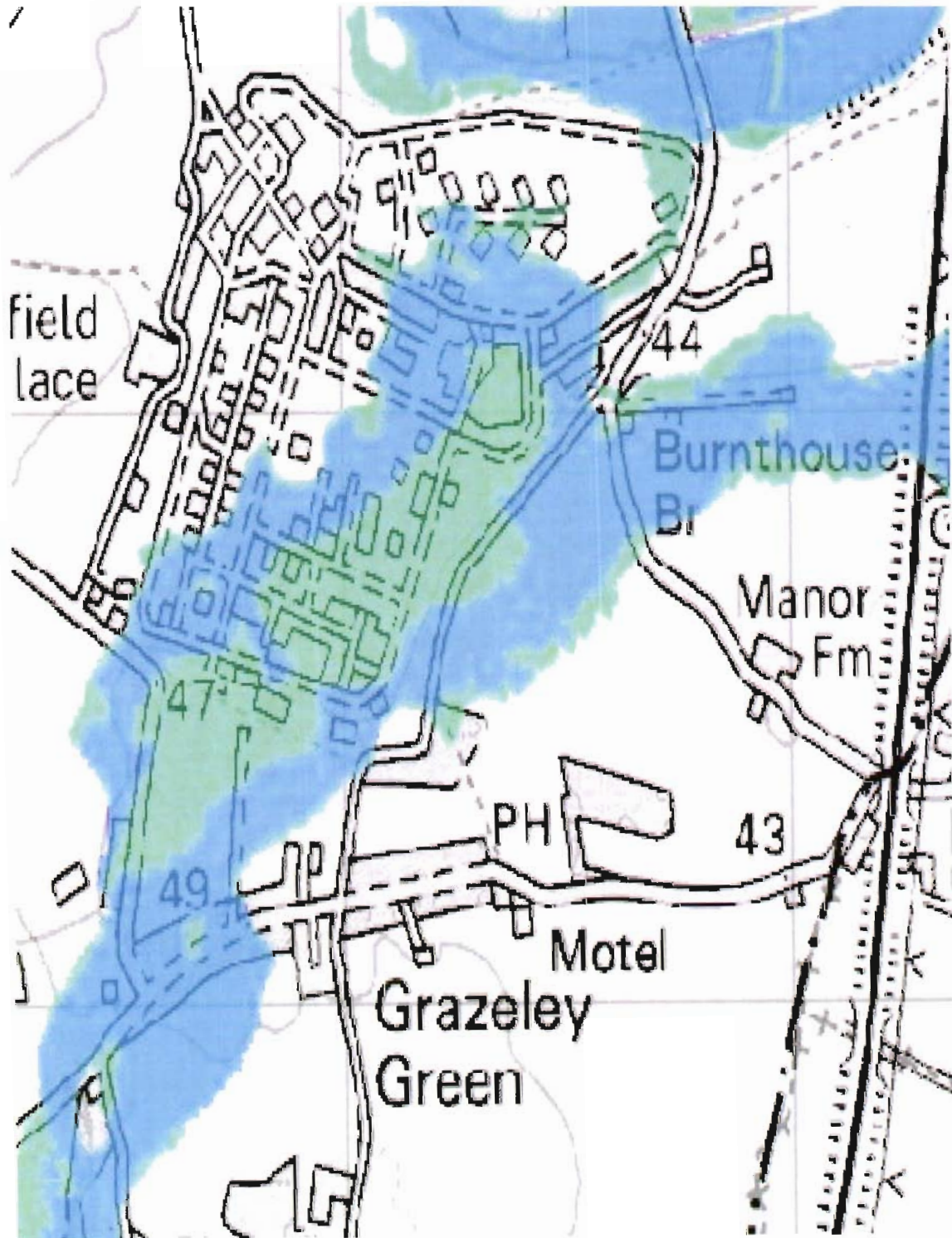


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Annex J Environment Agency Flood Plain Map





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Annex K Information Summary of AWE (B) Utilities Strategic Plan Key Deliverables

Deliverables	Target Date	Status
Impermeable Area Survey	Sep 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Flow Survey	Dec 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Manhole and Sewer Survey	Dec 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Creation of Site Specific Rainfall Profiles	Jul 06	This is underway but has been impacted by funding-related issues. This is a UHED-managed activity being undertaken by [REDACTED].
Computer Based Network modelling	Apr 07	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Hydraulic Analysis	Apr 07	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note.
Negotiations with the Environment Agency	On Going	AWE and the EA have well-established, successful negotiations on AWE Surface Water Drainage/SUDS issues. Key AWE team members are [REDACTED].
Determine SUDS Options	Sep 06	Currently SUDS options are being addressed by the individual Schemes. In order to establish a unified, efficient, economic approach to the design and Planning Submissions of SUDS, a specialist design house is being considered to be appointed to provide corporate solutions. Surface water drainage is a critical aspect of AWE Planning Submissions and receives heavy scrutiny. This is a UHED/Sites Development-managed activity being undertaken by [REDACTED], and is sponsored by DI. Progressing well.
Land Drainage Legislation Review	Dec 06	Deliverable completed. This is a UHED-managed activity being undertaken by [REDACTED].

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Annex K (continued) Information Summary of AWE (B) Utilities Strategic Plan Key Deliverables

Deliverables	Target Date	Status
Develop Policy on Flood Protection	Dec 06	Deliverable outstanding. The Utilities Steering Group was established to address this type of corporate risk issue ([REDACTED]). Current status unknown. 12(3)
Detailed Study of the site Hydrogeology	Dec 06	Deliverable outstanding. Activity has not commenced and is still a requirement. See funding note. 12(5)(a)
Evaluation of Extreme/Catastrophic Events	Dec 06	This is underway but has been impacted by funding-related issues. This is a UHED-managed activity being undertaken by [REDACTED]. 12(5)(a)

Funding Notes

Utilities & Highways Engineering Dept (UHED) was funded to carry out this activity under the DI PIR-approved Business Case 'AWE Utilities Engineering FY05-06 to FY07-08 NWCSP – AWE Utilities' Doc Ref EDMS1/800B61F1/B/ES1300. This was approved by DI PIR in 2005.

In 2006, funding for the water supply and waste water drainage activities was transferred from UHED by the Project Sponsor with the intention of tasking [REDACTED] with these activities.

[REDACTED] were seen at that time as having the potential to provide a unified supply of all utilities services, and was obviously in keeping with Procurement Dept's drive to streamline the supply chain by rationalising the number of suppliers. 12(5)(a)

UHED recently has had funding provisionally restored and has been instructed to resurrect the original programme activities.

The progress and financial status of the DI PIR-approved Business Case 'AWE Utilities Engineering FY05-06 to FY07-08 NWCSP – AWE Utilities' will be presented to PIR imminently (provisionally scheduled for 2 Oct 2007).

Management Notes

UHED is an operational area of DI Engineering Services (DI / ES)

UHED primarily provide specialist-engineering services to Site Utilities, via the [REDACTED] for Utilities and the [REDACTED] for Roads & Grounds. 12(5)(a)

The current Project Sponsor for UHED services is [REDACTED], DI Project Sponsor (Utilities). 12(3)



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Annex L Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Contact Lists		
1	<p>In the immediate aftermath of the incident it may have aided the recovery if key people (Leadership, Facility Managers, Suppliers, etc.) had attended site to assess the level of damage and begin formulating a strategy for bringing the site(s) back into operation. It was noted that there was no expectation for key staff to attend site during the weekend (although some did), no plans existed for readily contacting key staff and personal contact details were not always available.</p>	<p>At the BoardEx1 Exercise, it was identified that there was a requirement for an HR Policy and Process to specify how contact lists are collated and made available.</p> <p>It is recommended that this action be revisited and specific consideration be given to the mechanism for alerting key staff in the aftermath of an incident.</p>
2	<p>The Responders had no means of ascertaining the contact details of suppliers during out of hours working.</p>	<p>It is recommended that key supplier details (where applicable) be available for out of hours contact. A process is required for ensuring that this information can be sourced by Responders during out of hours operations.</p>
3	<p>Due to the absence of contact lists Line Managers were unable to take steps to advise personnel who worked within severely flood damaged facilities not to return to work the following Monday.</p>	<p>Telephony have the capability to communicate key messages simultaneously to all staff through the use of an automated system. However, this system is not commissioned and would require staff to be willing to submit their own contact details.</p>



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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
MDP		
4	The Burghfield MDP [redacted] was severely affected by flood damage.	It is recommended that MDP undertake a joint risk review with DI to identify the resilience of existing [redacted] and their requirements across all sites for [redacted].
5	The MDP sought authority to replace equipment that had been flood damaged. It was unclear how this authority should be sought or granted.	Clarification as to the process for the replacement of MDP equipment is required for any future Business Continuity incident to ensure they are aware of communication channels. This was identified previously at the joint Pandemic exercise and is currently under review by the [redacted].
Communications		
6	Whilst it was a prudent step to limit the disclosure of information surrounding the degree of impact suffered - particularly at Burghfield, it did result in staff at Aldermaston being very much unaware of the severity. This resulted in initial response efforts, particularly from Aldermaston, being less swift than the incident demanded.	The BoardEx1 exercise highlighted the requirement for a Business Continuity Recovery Support Team to be quickly convened and be able to support and respond effectively to operational requests both at and between sites. A central point of contact for BC and the invocation process for the Business Continuity Recovery Support Team is proposed within the Crisis plan (issued for comments 07/09).
7	The AWE Staff Information Line was not updated so employees were unable to get an up to date situation report.	It is recommended that the existing process for updating the staff information line be reinforced.

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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Communications		
8	<p>A company statement was not released to staff in the immediate aftermath of the incident that gave the 'company line' if questioned by the media. Whilst this had no obvious impact, if the site had attracted more media attention it could have resulted in unsolicited information being released.</p>	<p>The requirements of a crisis communication / instigation plan were identified at the ML and AWE plc board exercise in Feb 2007. The draft is currently under review.</p> <p>In the interim it may be prudent to remind staff of the requirement to direct any media interest to Corporate Communication.</p>
9	<p>communication devices were available, but were not used.</p> <p>However, it should be noted that neither the NII or EA could be contacted during the immediate aftermath of the incident and other Stakeholders were primarily contacted on mobile phones thereby eliminating any usefulness that secure communications would have offered. It was only considered to be a slight issue when the Aldermaston Emergency Manager was conversing with the Burghfield Emergency Controller.</p>	<p>It is recommended that the existing process for the use of secure lines be reinforced and communicated to those who may ever have a requirement to use them.</p> <p>The fact that communications were not used when the Aldermaston Emergency Manager was conversing with the Burghfield Emergency Controller is the subject of an RLI event on 17/09/07.</p>
10	<p>A number of the site providers associated with recovery continue to be overwhelmed by the number of calls asking them for updates on service recovery progress. This has hampered recovery efforts, particularly for IT and Telephony.</p>	<p>It could be considered a role of the Business Continuity Recovery Support Team to ensure regular updates via Corporate Communications are undertaken as to the status of service recovery.</p>

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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Procurement		
11	During and in the aftermath of the incident, the Procurement Chain was used to purchase essential supplies and to draw upon existing call-off contracts for support. Reports suggest that initial efforts to follow the usual Procurement Process caused frustrating delays.	The BoardEx1 exercise highlighted the requirement for Procurement, Finance and HR / Corporate Communication to be able to initiate a crisis mode for supporting operational requests. This crisis mode may circumvent and then revisit (once crisis MoDe is rescinded) some of the standard process requirements thereby expediting the process. It is recommended that this requirement be revisited.
12	During the incident it was unclear how to source a company credit card and whom within the company were already card holders. Furthermore, it was discovered at a later time that if these cards were used with unapproved suppliers, such as to purchase fuel for a site vehicle, the limit of liability was £50.	It is recommended that the existing process for maintaining the list of company credit card holders be reinforced and if appropriate modified such that the list is readily available in an emergency. It is also recommended that Finance consider raising the credit limit of credit cards for crisis use with unapproved suppliers.
Finance		
13	An emergency work package number did not exist before the event and therefore it was not immediately clear how incurred expense should be logged.	The BoardEx1 exercise highlighted the requirement for a Business Continuity Recovery Support Team to have a prearranged work package number for Business Recovery incidents, though this was deemed unnecessary upon review. It is recommended that this requirement be revisited. It should be noted during the reassessment that the work package number would benefit from being subcategorised to allow for more accurate spend analysis and reporting.



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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Telephony		
14	<p>The AWE(A) [redacted] alarm sounded once water encroached the pit underneath the [redacted]. Water ingress was as a result of inadequate sealant around the [redacted] that entered the building and to a lesser extent due to water ingress through the air bricks. If pumps had not been sourced to remove water from the pit, it is surmised that the [redacted] would have been irreparably damaged ceasing [redacted].</p> <p>It should be noted that this incident has highlighted that our [redacted].</p>	<p>A risk review had specifically been recommended for Business Continuity in conjunction with [redacted], which is due to commence at the end of Sept 2007. This will assist compilation of an action plan by [redacted] to reduce our level of risk exposure.</p>
15	<p>Telephony have limited means of identifying when faults occur in the network. They are almost entirely reliant upon faults being reported by users. This did not occur until staff returned to work the following Monday. Early identification of faults would have facilitated early resolution of defects prior to commencement of work on Monday morning.</p>	<p>A cost benefit exercise could be undertaken to determine if the delays associated with recovery are tolerable in comparison to the costs associated with a fault recognition system.</p>

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Log No.	Issue	Comments / Observations
Telephony		
16	<p>The AWE contract with █ ensures that security cleared Engineers are on call to provide assistance but are not dedicated to AWE. During the incident, it was identified that these █ Engineers had already exceeded their working time directive of hours and therefore could not provide immediate assistance.</p> <p>It should be noted that even if █ Engineers had been available, we would not have necessarily been a priority as the engineers are not a dedicated resource to AWE.</p>	<p>Considering the complexity, security issues and work requirements over the 4 AWE sites, an investment appraisal / business case should be considered to review the costs and benefits of having █ full time equivalent dedicated engineers within our █ contract.</p>
17	<p>Subsequent investigations have identified that some of the telephony faults were as a result of engineering works on site that had broken ducting exposing wires to a rising water table. Others were due to ageing infrastructure or sockets being exposed to water within facilities.</p>	<p>Controls have now been put in place to ensure that IT / Telephony are part of the package sign off for authority to proceed. This should help to prevent this issue occurring in future.</p>

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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Governance		
18	<p>Once the site has been brought to a safe and quiescent state it is the Responders prerogative to hand over responsibility for business recovery to the business. At the time of the incident there was no formally established group setup to coordinate business recovery, nor was there a process for doing so. Whilst a number of informal groups were established with the purpose of collating issues and managing the recovery of both sites, there was no clear focal point for understanding the company impact. Accordingly no log of business recovery decisions taken throughout the incident (including any justification) was maintained.</p>	<p>The BoardEx1 exercise highlighted the requirement for a Business Continuity Recovery Support Team to be quickly convened and be able to support and where appropriate aid the coordination of recovery.</p> <p>A central point of contact for BC and the invocation process for the Business Continuity Recovery Support Team is proposed within the Crisis plan (issued for comments 07/09).</p>
19	<p>AWE do not currently have formal Directorate Business Continuity Plans meaning that there was no pre-planned and rehearsed methodology for recovering essential company capabilities. This has meant that all recovery strategies have been determined in the aftermath of the incident, with the potential for conflicted priorities and timelines.</p>	<p>Whilst Directorate level plans may have assisted with a number of the immediate issues such as contact lists and purchasing issues, it is felt that they would have been of limited value to the actual recovery of capabilities. This is primarily due to the scale of the incident and the fact that a number of the capabilities affected are unique and could not have been recovered using alternative facilities or equipment.</p>



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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Governance		
20	Those involved in cleanup operations (who were not part off the emergency response crews) were prevented from working (in some instances) due to the non availability of the correct PPE.	Emergency responders do hold the required PPE in the required quantities to conduct cleanup operations. However, Facility Managers and other staff who wanted to be involved in the cleanup operations did not always have access to the required PPE. Whilst it was an issue during the immediate aftermath of the incident that PPE such as Wellington Boots were not available, it is not considered appropriate that the company could hold supplies of such PPE to cover all eventualities as this would be both cost prohibitive and impractical to monitor and track. However, recognition by procurement for a fast track process (as suggested in item 11) for purchasing PPE type goods at short notice and with a short lead time would support swift operational recovery.
21	Those involved in cleanup operations (especially during out of hours operations) did not have access to provisions.	Numbers for local food suppliers could be included within the Directorate Plan Template.
22	Burghfield site canteen was flood damaged and was not opened for staff access when staff returned to work the following Monday. A mobile canteen was ordered and delivered albeit complications surrounded its entrance (and operation) on site with a gas bottle.	It is recommended that Procurement and the Business Continuity Team (where appropriate) work in partnership with our Suppliers to ensure that business continuity arrangements exist for continuing to provide services in the event that our on site facilities / equipment become unavailable.



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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Governance		
23	Much of the Burghfield accommodation was damaged resulting in a number of office staff being relocated. Accordingly, this resulted in staff being put into overcrowded conditions where facilities were limited.	Had Directorate Business Continuity Plans existed, they would have highlighted alternative accommodation for staff (where applicable) and the priority of the move. This would have alleviated some of the issues surrounding conflicting relocations.
24	Staff located within the Licensed Site at Burghfield (particularly MDP Officers) were, due to security requirements, unable to leave Zone 4 and due to the flood damage did not have access to toilets and washing facilities.	It is recommended that Procurement ensure that they have a readily available process for obtaining emergency facilities via our approved suppliers.
25	There was no formally established central recovery team for ensuring that resource for building recovery was controlled or prioritised. It should be noted that Site Control assumed the responsibility during the aftermath of this incident supported by Facility, [REDACTED] and Emergency Managers.	See Item 18 above.

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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Governance		
26	There was initially no definitive guidance that marked out what should happen to buildings and equipment that had been exposed to flood water. Some areas of the business disposed of any items that had been exposed, whilst others have been cleaning metal or hard wood items and returning them to service.	Guidance Document 'Flood Damaged Buildings Return to Operations Procedure' has been produced by DI in the aftermath of the flooding and should be referred to in future.
27	There was initially no definitive guidance that marked out what cleaning fluids could be used. Of specific concern was the impact that the use of mould killing fluids would have on the sewage treatment facilities.	It is recommended that Guidance Document 'Flood Damaged Buildings Return to Operations Procedure' be amended to include details of approved cleaning fluids.
28	There was initially no definitive guidance that defined what should be done with paper documents that had been immersed in water. As such much of this paper has been thrown away, (only applies to uncontrolled documents). Controlled documents have been stored although mould growth has likely made them irrecoverable.	It is recommended that Procurement in consultation with Business Continuity and Security undertake a cost / benefit analysis as to whether we should hold a call-off contract with a recovery service provider that could have reclaimed flood damaged documents.



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Annex L (continued) Business Continuity Recovery Issues

Log No.	Issue	Comments / Observations
Insurance		
29	The MoD loss adjustor did not have clearance to access AWE sites and assess the damage caused by the flooding. A delay of a few weeks was incurred whilst [redacted] clearance was sought and granted.	It is recommended that the MoD ensure that they have more than one Loss Adjustor with the required clearance to access AWE sites.
30	It is unclear as to whether the asset register process is currently capturing all items that have been disposed from buildings.	It is recommended that Finance ensure ratification of the Asset Register once recovery has been achieved to avoid any future audit issues.



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Annex M Installed Example of

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