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SITE RESTORATION PROGRAMME

THE WINFRITH END STATE STEWARDSHIP PLAN

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WINFRITH END STATE:

Stewardship Plan

Review/Revision Register

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Glossary

Term	Definition	
Designation	The formal process by which a designating direction is revoked or amended by the secretary of state so that an installation, site, or facility (or part thereof) is no longer subject to that designating direction.	
Disposal	The permanent removal, deposit, destruction, discharge, or burial of radioactive waste, without the intent to retrieve later. Includes deposit of waste in a disposal facility, disposal for a purpose and disposal in-situ.	
Disposal for a purpose	On-site disposal of solid radioactive and non-radioactive waste, such as a buried structure, by leaving it permanently in position, together with any necessary preparatory works.	
Disposal in-situ	On-site disposal of solid radioactive and non-radioactive waste, such as a buried structure, by leaving it permanently in position, together with any necessary preparatory works.	
End State	The condition of an NDA site (or part thereof), following all physical decommissioning and clean-up activities required to conclude the NDA's mission for that site.	
Inadvertent human intrusion	Any human action that unintentionally disturbs radioactive substances, or that impairs a barrier or measure providing an environmental safety function, after the release from Radioactive Substances Regulation (RSR).	
Interim end point	The condition of the Winfrith site (or part thereof), following all physical decommissioning and clean-up activities required for the next planned use of the site (or part thereof)	
Monitoring	Continuous or periodic observations and measurements by which the operator maintain awareness of the condition of the site and any changes to that condition, and where relevant the surrounding area to help evaluate the impact of the site.	
Near-surface disposal facilities	Facilities located at the surface of the ground or at depths down to several tens of metres below the surface. Near surface facilities may use the geology (rock structure) to provide an environmental safety function but may rely solely on engineered barriers. The proposals for Winfrith are not defined as near surface disposals.	
Period of responsibility	The nuclear site licensing regime in NIA65 fulfils two purposes: it makes provision for nuclear safety regulation, but also underpins the legal framework for nuclear third- party liability in the UK. The liability regime makes licensees responsible for nuclear occurrences on-site and requires licensees to take out insurance or provide other financial security. The period during which the licensee is subject to the requirements of the liability regime is described in NIA65 as the licensee's 'period of responsibility'. When ONR is satisfied that there has ceased to be any danger from ionising radiations from anything on the site, it has the power to end the licensee's period of responsibility. The period of responsibility is the period from the date a nuclear site licence is granted until the earliest of the date when: (a) ONR provides written notice that there has ceased to be any danger from anything on the site; or (b) a new licence has been granted for the site; or (c) the site is used or occupied by the Crown and no longer requires a licence.	



Term	Definition
Site Reference State	The condition of a nuclear site when it is fully compliant with the requirements for release of the site from RSR. This condition may be achieved after an operator has completed all planned work involving radioactive substances, or after a subsequent period of control for the purpose of radiological protection.
Site-Wide Environmental Safety Case (SWESC)	A documented set of claims, made by the operator of a nuclear site, to demonstrate achievement by the site of the required standard of environmental safety. Where relevant, the SWESC includes the environmental safety case for any on-site disposal facility. The SWESC also takes account of contributions to the combined impact on representative persons from adjacent nuclear sites, and from areas of contamination and previously permitted disposals outside the site.
Site End State	The condition to which a site (or part of it) needs to be restored. The End State of a NRS Ltd. site will make it suitable for its next planned use.
Stewardship	Stewardship embodies the ethical and reasonable practice in land quality, environmental, and asset management. It includes understanding the value of the land assets and materials during the period for which the steward is responsible. The steward is often the liability holder who has the responsibility to ensure funding and knowledge management remain in place for as long as residual hazards exist.
Surveillance	Close observation of specified aspects of the nuclear site by the operator during the lifetime of the permit. After completion of all planned work involving radioactive substances, surveillance is needed during any period of control to ensure that the assumptions in the SWESC remain valid. Surveillance determines whether any physical actions not previously planned, or interventions to prevent actions by others, may be needed to restore or maintain consistency with the SWESC.
[Period of] validation monitoring	[period of] monitoring to confirm that the condition and behaviour of the site and where relevant the surrounding area, is in accordance with the assumptions of the SWESC. Validation monitoring is conducted by the permit holder and may continue for a period after the completion of all planned work on site involving radioactive substances [before release from RSR].



1 PURPOSE AND SCOPE

The purpose of this report is to:

- Set out the management control arrangements (termed stewardship in this report) for the Winfrith End State following the construction of the proposed disposals and deposits at the Steam Generating Heavy Water Reactor (SGHWR) and the Dragon reactor;
- Describe the environmental monitoring that will be carried out to validate the case that the Site End State meets requirements for protection of people and the environment; and
- Confirm the requirements for managing the site into the next planned land use, as described in the Restoration Management Plan (RMP) through to the Site Reference State (SRS).

The environment agencies guidance on the 'Management of radioactive waste from decommissioning of nuclear sites: Guidance on requirements for Release from Radioactive Substances Regulation,' the GRR (Ref. 1), notes for the site's Waste Management Plan (WMP) and Site Wide Environment Safety Case (SWESC):

'This guidance describes how the WMP and SWESC should be developed and used throughout the lifecycle of a nuclear site. We focus on how these tools should be used to optimise the management of wastes arising from decommissioning and clean-up and how they demonstrate that a site has achieved its site reference state so it can be released from RSR.'

The GRR goes on to note:

'After all planned work involving radioactive substances is complete, it may still be many decades before the site can be released from RSR. During this period further controls may need to be exercised on the site to ensure the radiological protection of people and the environment, until the site reference state is reached.'

The following regulatory submissions have been made to the Environment Agency (EA):

- An application to vary the Winfrith Site Environmental Permit issued under the Radioactive Substances Regulation (RSR) to allow disposal in-situ and for a purpose of the SGHWR and Dragon reactor structures. The application to vary the Permit has been underpinned by the SWESC and WMP that demonstrates the on-site disposals are optimised and meet the risk and dose criteria associated;
- An application for a Deposit for Recovery (DfR) permit has been submitted to allow recovery of non-radioactive waste for use in backfilling voids (Ref. 2). Appropriate after care of recovery operations has been considered as it is a requirement of the permitting process.

The site has also applied for planning permission to undertake a waste disposal and recovery operations on the site as defined under the Town and Country Planning Act (TCPA), alongside associated engineering works linked to decommissioning and site restoration. Proposed waste disposals have been identified as a Schedule 1 operation under the Environmental Impact Assessment (EIA) Regulations.

The report is one of the Tier 2 topic reports required to support application for suitable permissions as set out in Figure 1. It seeks to address the requirement to set out the 'further controls' and 'after care' noted above, that need to be demonstrated to meet the EA expectations from the construction of on-site radioactive disposals through to the SRS.

The main objective of the Winfrith site decommissioning programme is to decommission and remediate the site up to the Interim End Point (IEP). At that point, it is assumed the site's security fence would be removed, allowing for public access (Ref. 3).

Figure 1: Hierarchy and content of the Winfrith End State permit document suite



An essential element of the Stewardship Plan is the period of ongoing control between the construction of the Dragon and SGHWR disposals and the SRS. This is intended to deliver the following principal outcomes:

- Assurance of continued protection to people and the environment;
- A period of surveillance that will build confidence that the disposals perform as anticipated in the SWESC;
- Management arrangements to support the next planned land use that have been agreed with stakeholders;
- Timely identification of disposal cap disturbance, e.g., from natural events or by inadvertent human intrusion;
- Instil confidence among stakeholders and other parties regarding the management of the site up to the SRS;
- Provision of evidence to support the case to remove the regulatory controls enacted by the RSR permit.

The scope of the Stewardship Plan includes:

Land area: All the land within the site perimeter fence, including the licensed area and the land which is delicensed. Specific land area exclusions from the Stewardship Plan are set out in Table 1 below.

Timeframe: This covers three phases:

• Phase 1 between the construction of the Dragon disposal through to the site reaching its IEP. Before the IEP all above-ground buildings and hard-standing areas will be removed with areas being available for natural habitat regeneration;



- Phase 2 between the IEP through to achieving the SRS. Stewardship will be the only work activity carried out on site during this period. Safe public access will be provided on the site and habitats will be allowed to regenerate;
- Phase 3 after the SRS. This will only consist of record management and any insurance necessary should there be any remaining liability. All regulatory controls relating to the disposals / deposits will have ceased. There may be other physical tasks that need to be undertaken, such as maintaining foot paths and the fence to the Dorset Innovation Park (DIP), as well as continued management of habitats and heathland. A management organisation will continue to manage the site during stewardship.

The exclusions from the Winfrith Stewardship Plan are set out in Table 1.

Exclusion	Underpinning	
Land outside the site perimeter fence and the permit and license boundaries.	The Winfrith site is owned by the NDA and managed by NRS as the Site Licence Company (SLC) and Permit holder under leasehold from the NDA. The NDA land holding is larger in size than the NRS leasehold area. Similarly, some of the NRS leasehold land area lies outside the fence, permit, and licence boundaries (Figure 3).	
Commercial development in the northern part of the site within the site fence.	The original End State consultation with stakeholders in 2007 on next land use at Winfrith identified the possibility of some commercial development in the northern end of the site, within the current perimeter fence, to maximise economic benefits of the rail head (Ref. 8). However, there have been no economic uses identified to date and therefore the assumption is that any commercial development on the site is excluded.	
Stewardship of the Scottish & Southern Electricity (SSE) sub-station and related infrastructure	An electricity sub-station, that previously received electricity produced by SGHWR, is located in the southwest corner of the Winfrith site, and high voltage overhead power lines from this head north across the site. SSE own the sub-station equipment and power lines however the land is under a leasehold from NRS / NDA. The sub-station equipment will continue to operate after the IEP and potentially after the SRS. Should NRS surrender the site lease before the SSE lease term expires, then it is assumed that the NRS responsibilities in the sub-lease transfer to NDA as the superior landlord. It should also be noted that the various distribution substations across the site are also on a separate sub-lease between NRS and SSE and are expected to become progressively redundant. Normally SSE would leave such infrastructure in-situ to service future developments but given the intended next use of the land is heathland, this would have little benefit and the distribution stations will be decommissioned. The sub-station is not included in the Stewardship Plan.	
Stewardship of the Effluent Pipeline	Most of the land between the Winfrith site along the route of the pipeline is owned by private individuals and other organisations and has mixed land use including agricultural uses, light industrial and ministry of defence operations. The pipeline extends onto the seabed but remains within the 12 nautical miles owned by the Crown Estate. It is assumed the pipeline and all associated liability will be removed by the IEP and there is no requirement to include it within the Stewardship Plan.	
Stewardship of the Blacknoll Reservoir	The Blacknoll Reservoir, a concrete structure situated on a hill to the southwest of the site, was built to ensure adequate supplies of reactor process and emergency water. There is no requirement for on-going management as the facility will be decommissioned, with no ongoing NDA liability, and there is therefore no ongoing stewardship for this facility.	

Table 1: Exclusions from the Winfrith End State Stewardship Plan



2 CONTEXT

2.1 Location and setting

The principal features of the current site and its immediate surroundings are shown in Figure 2. Figure 3 shows the land holdings, whilst Figure 4 shows the proposed site at the IEP, the point when decommissioning of the site and operations involving radioactive waste are complete.

Figure 2: Principal features of the current Winfrith site and its surroundings



There is a detailed understanding of the:

- Site and hydrogeological environment that underpins the risk assessments (Ref. 4, 5);
- Radiological and non-radiological backgrounds in groundwater and in soil (Ref. 6), which forms a baseline for monitoring once the disposals have been formed.





Figure 3: Winfrith land NDA freehold current and former ownership

Figure 4: Principle features of the Winfrith site and its surroundings at the IEP



The Site Description report provides more detailed information on the site (Ref. 7).

2.2 Winfrith End State optimisation

The Winfrith End State has been defined through optimisation studies as set out in the GRR. The optimised approach, including managing some wastes in-situ, is in accordance with the



Dorset Council (DC) local plan, delicensing guidance, and groundwater protection regulations. The optimisation assessments considered the benefits and detriments of the management options and included an input from stakeholders and representatives of the local community (Ref. 8, 9, 10, 11 and 12).

The optimised End State includes on-site disposals of radioactive waste (in-situ and for a purpose), and deposits of recovered wastes at SGHWR and the Dragon reactor (including the Dragon mortuary holes).

These disposals and deposits of wastes are a combination of the following:

- Disposal in-situ of radioactive below ground structures (which are deemed to be radioactive waste) at SGHWR, Dragon reactor and the Dragon mortuary holes;
- Disposal of radioactive waste (blocks of concrete and broken concrete from demolition of the above ground building structures) for a purpose, namely infilling of below ground voids as part of enabling heathland to reestablish on site;
- Use of non-radioactive wastes (blocks of concrete and broken concrete; the latter both aged and newly broken) in a DfR operation, also for the purpose of infilling below ground voids (for example in the SGHWR annexes) as part of enabling heathland to reestablish on site.

3 REQUIREMENTS FOR THE STEWARDSHIP PLAN

This section sets out how constructing the stewardship plan has flowed down from relevant international and national standards, leading through the regulators GRR requirements, coupled with lessons learnt from stewardship planning and implementation at other nuclear and non-nuclear sites in the U.K. and abroad.

3.1 Standards and guidance from the IAEA, the Joint Convention, and the NEA

Many countries have complex nuclear legacies, similar to Winfrith. Few sites are fully closed, and regulators and operators are presently considering issues related to long term safety. International standards and guidance play an important role in shaping national requirements and plans. Indeed, the GRR, as well as other radiological and non-radiological regulatory controls, take account of international guidance. The International Atomic Energy Agency (IAEA) and Nuclear Energy Agency (NEA) are key sources of international standards and guidance, and there have been several important developments through their work.

The IAEA has prepared a Safety Guide on the classification of radioactive waste (Ref. 13). The classification scheme is explicitly linked to the disposal method. A key factor in defining the boundary between waste classifications is related to the risk from intrusion and disruption that may occur close to the surface. This in turn is related to the capability for management control.

The IAEA has also set out a number of safety requirements addressing site stewardship that should be met by radioactive waste disposals (Ref. 14), namely:

- The long-term safety of a disposal facility for radioactive waste must not rely on active institutional control;
- Even if passive safety engineering features are bypassed by human intrusion, doses should not exceed the recommended criteria for intervention (20 mSv).

Another important international source of requirements is the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (known as the "Joint Convention") (Ref. 15). Countries with significant nuclear programmes are contracting parties to the Joint Convention. It places obligations on contracting parties to develop plans for the closure of waste disposal sites and making necessary arrangements for active and passive institutional control. The Convention has articles specifically relating to institutional control (stewardship):



Article 16: Operation of facilities

Each Contracting Party shall take the appropriate steps to ensure that:

........ plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

Article 17: Institutional measures after closure

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

.....records of the location, design and inventory of that facility required by the regulatory body are preserved; active or passive institutional controls such as monitoring or access restrictions; are carried out, if required; and if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

Although the Winfrith disposals are not built for purpose disposals, and there is no intent to accept wastes from other sites, it is assumed both articles are also relevant for the Winfrith disposals.

Other IAEA experience has contributed to the development of the Winfrith End State. This has included the Determination of Environmental Remediation End States (DERES) programme (Ref. 16). The programme scope included processes for determining the End State for environmental remediation. It also considered factors, such as radiological risk, chemical risk, socio-political and regulatory requirements that impact achieving an End State suitable for the intended future use.

The NEA programme on a 'Holistic Process for Decision Making on Decommissioning and Management of Complex Sites (HDCS)' (Ref. 17) provided guidance on End State decisionmaking for complex sites. The guidance has included preparation of a reliable, effective, and efficient process that identifies, assesses, controls, and manages risk(s) associated with complex site decommissioning and legacy management.

3.2 Regulation by the Environment Agency

NRS Winfrith is applying for Environmental Permits (RSR and DfR), which have attendant requirements in legislation and guidance.

GRR compliance

Requirement R8 of the GRR states: "Operators should carry out a programme of site characterisation and monitoring to provide information needed to support the [Waste Management Plan] WMP and SWESC. The programme shall include appropriate validation monitoring to provide technical confirmation that progress towards the site reference state is as expected or to validate that the site reference state has been achieved." [2, para. A4.12 in (Ref. 1)].

Requirement R8 stipulates that site characterisation and monitoring need to establish in sufficient detail [para. A4.14 in (Ref. 1)]:

- The geological properties of the site, including the lithology, the stratigraphy, the geochemistry, and the local and regional hydrogeology;
- The potential for, and effects of, dynamic geological processes that may be significant to the SWESC;



- The resource potential of the area under and near the site so as to assess the extent to which the site and its surroundings might in future be disturbed through exploitation of the resources;
- The nature, magnitude and distribution of the radiological hazards remaining on or adjacent to a site;
- The nature, magnitude and distribution of any non-radiological hazards associated with, or potentially interacting with, the radiological hazards;
- Past and present rates of movement and diffusion of these hazards, if for example transported by groundwater, so that extrapolations can be made into the future;
- Uncertainties in each of the above.

The EA states in the GRR the requirements for environmental monitoring:

- Operators should establish a reasoned and proportionate approach to monitoring their site and any disposals it may contain. The monitoring programme will provide data during the period of RSR to ensure that the behaviour of radioactive substances on or adjacent to the site is consistent with the SWESC assessments;
- During the period of RSR, operators must continue to carry out radiological monitoring and assessment to provide evidence of compliance with the limits and conditions of the RSR permit and assurance of radiological protection of members of the public. Operators should also ensure that changes in the parameters monitored are reflected in the SWESC;
- The monitoring programme must set out clearly the levels of specific contaminants that will trigger action. It must include an action plan to deal with unexpected levels of contamination and an approach to confirm any positive results to avoid inappropriate action being taken in the event of a false positive observation. The monitoring programme must be reviewed in the event of any changes to decommissioning plans or subsequent change of uses of the site.

DfR compliance and experience in non-radioactive recovery operations

In addition, a DfR permit application has been submitted alongside an application to vary the current RSR Permit to allow disposals under GRR (Ref. 2). As the proposed DfR operations are in the same place as the proposed GRR operations, there is significant overlap and shared stewardship requirements. The requirements arising under a DfR permit are termed 'after care' in landfill guidance (noting that the Winfrith disposals are not a landfill). Typical after care activities include groundwater and surface water compliance monitoring and monitoring cap subsidence.

However, not all after care activities required for landfills are needed and justifications based on the low hazard of the concrete and brick waste forming the SGHWR and Dragon disposals are presented in the DfR permit application. This includes excluding gas and leachate monitoring.

The Winfrith Stewardship Plan also considers the experience in managing equivalent nonradioactive waste sites. The Winfrith End State recovery operations will consist of stable and inert materials and therefore there has been merit in considering the aftercare requirements for stable non-reactive landfills (Ref. 18).

Groundwater Regulations

In addition to the GRR and DfR requirements, the EA has a broader role in environmental protection which is relevant to the proposed Winfrith End State. For example, the EA regulates the Groundwater Regulations 2008 and the Water Environment Regulations 2017 (Ref. 19). These enact parts of the Water Framework Directive and the Groundwater Daughter Directive. The regulations prohibit direct discharges of any type from entering groundwater, and further operators are required to prevent and limit in-direct discharges to groundwater.



Anticipated changes to the regulation

The Department for Energy Security and Net Zero (DESNZ) has started to implement changes to legislation and regulation through the Energy Security Bill (2023), which will allow eventual delicensing of the Winfrith site, including radioactive wastes disposed on the site. The regulatory changes will allow the site to be delicensed under the revised regulation and supporting guidance. (Ref. 20). As Winfrith's high hazards have been removed and the proposed disposals at Winfrith have a very low radiological inventory, continuing to apply the existing regulatory regime would be disproportionate to the risk. Stewardship arrangements need to meet the requirements set out in the sections above but are expected to be proportionate to the remaining risk.

3.3 Regulation by the Health and Safety Executive and the Office of Nuclear Regulation (ONR)

It is assumed for planning purposes that the Winfrith nuclear site license (issued under the Nuclear Installations Act 1964) continues to apply until the IEP. There may be options for most of the site to be delicensed prior to this, however these are currently not being progressed.

The site currently operates under the nuclear site licence and the management arrangements and control of decommissioning complies with these requirements.

3.4 Controls through the planning system

The local authority relevant to the Winfrith site is DC. It has responsibilities for the spatial planning framework that governs current and future land use and control of development and is the planning authority for waste management operations and land contamination regulation.

DC has been involved in considering the Winfrith End State through its development and through the consultation on the Local Waste Plan, as detailed in Policy 10 (Ref. 21).

The nationally and internationally designated habitats both within and adjacent to the site are also managed through the planning controls and a range of environmental legislation designed to protect designated habitats.

The agreed End State, including on-site disposal of radioactive wastes, supports delivery of the next planned land use of heathland with public access. The Environmental Impact Assessment (EIA) and Habitats Regulation Assessment (HRA) will inform planning decisions relating to the Winfrith proposals, including the stewardship plans.

3.5 Habitat designations

This Stewardship Plan identifies areas that are designated habitats including the Winfrith Heath Sites of Special Scientific Interest (SSSI), Dorset Heaths Special Protection Area (SPA), the Dorset Heaths Special Areas of Conservation (SAC) and wetlands designated under the Ramsar Convention. The habitat designations at Winfrith are set out in the Defra MAGIC (Multi-Agency Geographic Information for the Countryside) website (Ref. 22).

SSSIs are given legal protection under the Wildlife and Countryside Act 1981 (WCA 1981), in recognition of their special interest by reason of their flora, fauna, geological or physiological features. Natural England are responsible for designating such sites under WCA 1981, section 28. The owners of SSSIs are restricted in what they can do to and, on the land, and must manage the land so as not to cause any damage to it. Public bodies are also under a duty to take reasonable steps to further the conservation and enhancement of the special features of the SSSI (Ref. 23).

SACs are protected areas in the UK that are designated under the Conservation of Habitats and Species Regulations 2017 (as amended) in England (Ref. 24). These regulations require establishment of a network of important high-quality conservation sites that will make a significant contribution to conserving the habitats and species identified in Annexes I and II,



respectively, of European Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, known as the Habitats Directive.

SPAs are protected areas for birds in the UK classified under the Conservation of Habitats and Species Regulations 2017 (as amended) in England (Ref. 25). They are classified for rare and vulnerable birds (as listed on Annex I of the Directive), and for regularly occurring migratory species.

There are significant restrictions on developments affecting a SAC or SPA. The appropriate authority is required to undertake an appropriate assessment of any plan or project that is likely to have a significant effect on a SAC or SPA. This is known as a HRA in England. Importantly, if a plan or project has a negative assessment and there is no alternative solution, it can only be undertaken if it is for "imperative reasons of overriding public interest" (IROPI), including those of a social or economic nature.

The Stewardship Plan and the associated RMP (Ref. 26) are aligned with the Conservation Objectives for Dorset Heaths SAC and SPA, and are cognisant of sensitive ecological features, including protected species and designated sites. Consultation with Natural England as part of the development of the RMP has identified that the restoration process, including decommissioning of existing drains and creation of a mire feature ahead of the stewardship phase, is in accordance with the Conservation Objectives that need to be met through the stewardship phase.

It should be noted that within the temporal scope of the Stewardship Plan and the RMP there may be changes in legislation and policy relating to designated sites. Therefore, these documents will be reviewed periodically following an agreed review cycle, to ensure that they reflect the current protection afforded to habitats at Winfrith.

3.6 Expectations of stakeholders

The main interaction with stakeholders in terms of their expectations has been through the End State stakeholder engagement process. This ensured the expectations of stakeholders have been included in strategic decision-making that has informed the current proposals. The site has engaged with the local community and more widely regarding End State development since 2006 and community views have shaped the strategic and detailed plans (Ref. 8, 9, 10, 11 and 12).

There are regular community and stakeholder group meetings where information and options are shared and they will continue through End State development and implementation. Wider engagement beyond the local area has involved postal and web-based communications.

3.7 Stewardship experience in the UK and elsewhere

Experience within the UK

At the present time multiple nuclear sites in the UK are at various stages of decommissioning and End State development:

- NRS Trawsfynydd site has submitted proposals for the demolition, infilling, and capping of the Trawsfynydd Ponds Complex to Natural Resources Wales (NRW) (Ref. 27). An environmental monitoring plan was submitted with the GRR permit application, but no stewardship plan was prepared as decommissioning will continue for many decades. It is anticipated that a stewardship plan will be developed for the whole site at an appropriate time several decades into the future;
- Dounreay is a complex site which considered the evolution of the site through decommissioning phases with the potential for residual contamination to remain below ground, monitored for up to 300 years to ensure long-term safety. The post-restoration phase assumes there are no stewardship controls, other than normal development restrictions. Dounreay developed an Institutional Control Plan for their new Low Level Waste disposal



facility, D3100 which considered similar issues dealt with in this report, such as organisational arrangements, contingency funding, land use control, monitoring and surveillance, intervention strategy and record retention (Ref. 28). The proposed approach was based on active control following closure of only a few years to demonstrate the disposal system behaved as expected;

 The LLWR Environmental Safety Case (ESC) includes the development of strategies for long term stewardship. LLWR intends to maintain control of the site for as long as reasonably practicable (Ref. 29). Historically the assumptions have been for active stewardship for 100 years for the purposes of the site's ESC, beyond which no credit is taken for the controls in the calculation of potential future doses and risks.

Different stewardship strategies exist across various UK sites, but there is no site that can be used as a template for Winfrith.

Stewardship experience outside the UK

Typically, ESCs produced for existing near surface repositories in Europe, at sites such as Centre de l'Aube (France) (Ref. 30), Loviisa (Finland) (Ref. 31) and El Cabril (Spain) (Ref. 32), manage higher levels of radioactivity. Consistent with IAEA guidance, their ESC's do not rely upon controls beyond a few hundred years, with a 300 year-timeframe the maximum considered. This timescale often allows for a thousand-fold reduction in the concentrations of Cs-137 and Sr-90 (relatively short lived radionuclides). A shorter period of 100 years is sometimes assumed if the inventory is such that a longer period of control brings little benefit in reducing radiological risks, with inventories being dominated by short (e.g. H-3) or very long-lived radionuclides. The Centre de Stockage de la Manche repository in France is a good analogue for LLWR, and the site's operator, ANDRA, has defined three phases of stewardship (Ref. 33):

- High level surveillance which lasts 5 years to assess the performance of the cap;
- Active surveillance of 50-100 years with environmental monitoring and engineering maintenance, as necessary. The objective being to confirm any cap change does not compromise its ability to meet the requirements, and to determine any need for strengthening;
- Passive surveillance for a short period, with reduced management, although the site remains under control. In this phase, the aim is to demonstrate final site release will not result in any unacceptable environmental consequences;
- Whilst the stewardship activities proposed or undertaken at these disposal facilities are similar to those considered for Winfrith, they do not reflect the lower risks expected on site.

An alternative perspective is gained from the approach to stewardship in the United States, (Ref. 34, 35) where disposal facilities and other "legacy" sites have detailed regulations and practices set by the regulators. This is a key difference from the approach adopted in Europe, where it is the responsibility of the site operator to develop stewardship plans. The US regulators define the requirements for the period of stewardship including requirements for long-term surveillance (usually for ~100 years), during which time it is necessary to control access, perform corrective actions (such as minor cap repair), monitor groundwater for potential contamination, assess disposal performance and report on dose limit compliance. The Rocky Flats (Ref. 34) and Fernald (Ref. 35) sites have achieved their respective End States, leaving restored land for ecological use, limited public access coupled with waste disposals in specific locations. This defined land use has been supported by collaborative decision-making with local stakeholders, where stewardship has been a key component in confirming End State delivery.

3.8 Controls through the Nuclear Decommissioning Authority

The NDA's strategic priorities, which are particularly relevant in developing and implementing the Winfrith End State, include:



- Encouraging the highest standards in environmental management;
- Securing the funding framework for site decommissioning and restoration;
- Gaining the support and confidence of stakeholders;
- Developing integrated and optimised waste solutions.

Furthermore, in 2006/2007, NDA sites, including Winfrith, consulted the local community on their aspirations for the next planned land use and site End State (its physical condition after NDA's work is complete) (Ref. 8). The outcome for the Winfrith site was identified by the community as being heathland with public access. This set an important context for the management controls (i.e., stewardship), by defining the end point expectations, including the potential use of the site after the IEP and SRS had been achieved.

Section 5 sets out the core strategic elements and assumptions that the NDA have agreed with NRS that underpin the Winfrith End State Stewardship Plan.

4 THE WINFRITH SITE END STATE

The Winfrith End State consists of:

- Permitted disposals of radioactive waste and recovery of non-radioactive waste at SGHWR and the Dragon reactor and in-situ disposal of the Dragon mortuary holes. Both Dragon and SGHWR will have engineered caps to prevent human and animal intrusion and minimise surface water ingress;
- Radioactively contaminated land and structures other than SGHWR and Dragon (identified as in scope of RSR) removed and managed off-site;
- All other surface features will be removed to meet the definition of next planned land use and ensure the site is suitable for public access. Most structures will be removed to at least one meter below ground level;
- Non-radioactive contamination of land or groundwater is suitable for the next planned land use;
- The SSE sub-station compound in the northern part of site will remain in place;
- Roads will have tarmac removed and surfaces will be broken up;
- Localised re-profiling in the northern part of the site to support habitat regeneration and ensure no detrimental flood risk;
- Eventual removal of the site fence to allow public access.

Stewardship of sites that have completed their decommissioning, waste management and restoration activities represents a new activity and phase of management for both the NDA and NRS. This new phase needs to be managed through appropriate arrangements, with flexibility as the understanding of the site develops and evolves.

5 ASSUMPTIONS UNDERPINNING THE STEWARDSHIP PLAN

The assumptions and key definitions underpinning the Stewardship Plan include:

- The land area covered by the Stewardship Plan;
- The boundary between the Dragon and SGHWR disposals and the rest of the site;
- Site ownership;
- Leasehold and management arrangements;
- When the site or part so the site can be delicensed and when it can exit nuclear third-party liability;
- When the site can be de-designated;
- When the site or parts of the site can achieve its SRS;
- When public liability insurance is no longer required;
- When the disposal permit can be revoked.



The high-level assumptions about the regulatory controls, insurance regime and management arrangements across the different stages of Stewardship agreed with the NDA are set out in Table 2.

Table 2: Stages and management requirements for remainder of Winfrith site lifecycle

Stage	Assumed regulatory controls	Assumed insurance regime	Management arrangements
From disposal at Dragon up to IEP.	Nuclear Site Licence and Environmental Permits (RSR and DfR).	Nuclear third-party liability.	Current arrangements and Stewardship of the Dragon disposal and then the SGHWR disposal.
Delicencing and fence removal. Permit surrender for majority of site land area.			
IEP to SRS.	RSR and DfR Environmental Permits.	Public liability insurance.	Stewardship Plan and minimal management.
Surrender of Environmental Permits			
Post-SRS.	Land use planning restrictions only	Not yet defined.	The site owner has not yet been identified.

The assumptions and key definitions are developed further in Table 3.

Table 3: Key assumptions and definitions for Stewardship of Winfrith Site

Key assumptions and definitions

Definition of site

The Stewardship Plan covers all the land referred to as the 'Site' which reflects the site perimeter fence. This includes the licensed area and the land which has been delicensed. The Plan excludes stewardship of:

- Facilities and land operated by TradeBe-Inutec Ltd;
- Facilities and land used by SSE;
- Winfrith Sea Discharge Pipeline and associated structures off the Winfrith site, which will be fully remediated;
- Land surrounding the decommissioned Blacknoll Reservoir, which will be fully remediated;
- Land north of rail line which currently has some assets / maintenance associated (boreholes / maintained channel).

The disposal area

The disposal area is defined as land immediately surrounding and linking Dragon and SGHWR. The area will be a single contiguous area, with the distance from the current site boundary to be confirmed through the Permit application process. The disposal area will be permitted until the SRS, envisaged to be circa 2070.

Ownership

The site continues to be owned by NDA up to the SRS.

NDA will own the land after the Site has reached its SRS until such a time it is sold.

Leasehold and management

The site continues to be leased to NRS, or its successor entities, until the SRS.

NRS continues to manage the whole site on behalf of the NDA until the Dragon and SGHWR disposals meet their SRS.

NRS management and lease cease at the SRS for the disposal area circa 2070.

Delicencing and exiting Nuclear Third Party Liability

Delicencing is assumed to be a prerequisite to achieving IEP (late ~2030s). The site will exit Nuclear Third-Party Liability regime at the time of delicencing.

De-designation

The whole site will remain designated until final Permit surrender in the late ~2070s.



Key assumptions and definitions

The SRS in non-disposal areas

The area of the site sitting outside the contiguous disposal area will reach its SRS at the site IEP (late 2030's). NRS will make application to the EA to surrender the Permit in these areas at this time.

Public liability insurance

NDA will arrange the public liability insurance from the time the site exits Nuclear Third-Party Liability (assumed to be at the IEP) until the land is sold or divested, assumed to be after the SRS.

Permit Revocation

GRR and DfR permits will be surrendered at the SRS for the disposal area, assumed to be in the late 2070s.

After the GRR and DfR permits are surrendered, land management controls will be through planning and development controls.

Following development and agreement on the underpinning assumptions, the anticipated regulatory phases and how they might be concluded is shown in Figure 5. The figure also sets out the significant activities leading through to the site's SRS. The key activities in the timeline underpinning the Stewardship Plan, depicted in Figure 5, are:

- The Stewardship Plan starts when the Dragon disposal is capped;
- The Stewardship Plan ends when the site's SRS is achieved;
- The nuclear site license is removed at the IEP, thereby leading to the EA being the sole regulator;
- Public access across the whole site is allowed from the IEP;
- If agreement can be reached with the EA, the SRS for the rest of site, excluding the disposal area, could achieve its SRS earlier as risk levels would be well within regulatory criteria. If that occurred then the rest of site would thereafter only be subject to planning restrictions and obligations set by DC at or near the site IEP;
- If land outside the disposal area (the rest of the site) cannot achieve the SRS at the IEP, then the whole site will then meet its SRS after a few decades of validation monitoring as a conclusion of the Stewardship Plan. The whole site would then be subject to the planning restrictions and obligations set by DC.



Figure 5: Winfrith End State stages: Site potentially meets early SRS, Disposal area meets later SRS



6 THE STEWARDSHIP PLAN PHASES

There are three key phases for stewardship of the site:

- Between the construction of the Dragon disposal through to the site reaching its IEP;
- Between the IEP through to achieving the SRS of the SGHWR and Dragon disposals;
- After the SRS of the SGHWR and Dragon disposals.

Phase 1 – up to IEP

Through Phase 1, the existing management arrangements, and controls to ensure compliance with the nuclear site licence and environmental permits (RSR and DfR) will remain in place. The nuclear third-party liability insurance will also remain in place. The management of the site up to the IEP will:

- Undertake disposal surveillance and validation;
- Ensure environmental safety requirements are met with no adverse impact on the natural environment;
- Generate and preserve appropriate records.

Elsewhere on site, the strategy is to manage the land through the Winfrith zone close out process (Ref. 36), ensuring each zone meets the Winfrith End State specification (Ref. 37). This will be through removal of plant, equipment, and structures, remediation, where required, and validation characterisation as necessary.

Phase 2 – IEP to SRS

There will be a range of management arrangements and controls in place through this period to demonstrate compliance with the Environmental Permits (RSR and DfR). The site will hold public liability insurance.

Phase 3 – After SRS

It is assumed there will be no management activities undertaken by NRS once the site has achieved its SRS, as by definition RSR controls will have ceased. The NDA will no longer have a radioactive liability to manage, there will be no requirement for a Permit holder. The site will then be controlled through development restrictions and there may be a need for public liability insurance provision by the site owner if there is public access to the land. It is assumed that the NDA will continue to manage site records beyond the SRS.

7 STEWARDSHIP PLAN COMPONENTS

7.1 Upkeep of the SWESC and underpinning assessments, including after care requirements

The SWESC will evolve through to a final version at the SRS. The EA's guidance on the periodicity of SWESC production set out in the GRR is (Ref. 1):

'The operator should maintain the SWESC in the light of factors such as developments at the site, new information, changes in legislation and government policy. They should update the SWESC at suitable intervals up to the release from RSR and should comprehensively review the SWESC at suitable intervals no less frequently than every 10 years'.

The proposed periodicity for updating the Winfrith End State SWESC is as follows:

- This version of the SWESC has been prepared for the permit variation application. Along with the SWESC, there is a WMP and other documents supporting the overall disposal case for the Winfrith End State;
- The EA and other regulators will review the permit variation application and it is possible, though not definite, it will lead to an update to the SWESC;
- A further update of the SWESC may be anticipated following the completion of all work on radioactive substances at the IEP, including environmental monitoring data up to and after



- Updated radioactive and non-radioactive inventories, based on records from disposals / deposits, as built;
- Any further optimisation completed to support the detailed design;
- A description of the detailed design and the 'as built' configuration;
- Any changes in modelled performance;
- The boundaries for environmental performance from the IEP;
- Further SWESC updates may be prompted by environmental monitoring data during the period up to the SRS. Should monitoring indicate that the disposals are not performing as expected, in a manner that would impact the claims, arguments, and evidence, then this may prompt a review of the SWESC and underpinning assessments. For planning purposes, it is assumed the SWESC will be reviewed every 10 years;
- A final SWESC will underpin the application to surrender the EA permits and demonstrate the SRS has been achieved. It will use the environmental monitoring data gathered over the previous decades to support the conclusion that the disposals have performed as modelled.

Figure 6 depicts the proposed SWESC versions.



Figure 6: Winfrith End State SWESC development through to the SRS

The SWESC provides the underlying justification that the Site End State, and the disposals, are safe and continue to be safe. Should any pillar within the claims, arguments and evidence provided within the SWESC be undermined, then the case itself might need to be revisited. Therefore, evidence needs to be collected regarding the site and disposal performance and that the regulators and stakeholders are informed early. Sections 7.3, 7.4 and 7.5 set out the proposals to provide evidence that the specified environmental performance has been met.

Section 7.6 considers the process for managing environmental monitoring results which could imply out-of-specification performance.

If there is new operational experience and learning from others that might influence the case, then any reassessment and/or remediation plan for the disposals or wider End State would need to be discussed with the EA and other stakeholders.

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DfR after care requirements

There are also requirements arising from the DfR permit and management of the associated deposits. After care is 'the period between the time the Environment Agency issues an after care permit until they accept the surrender of your environmental permit.' During after care, the site must be managed, maintained, and monitored to ensure that no pollution events occur and to confirm the waste is physically and chemically stable. Arguments are presented in the Environmental Site Setting Document (ESSD) (Ref. 38) and the SWESC which justify why some of the aftercare requirements are not necessary e.g., there is no need for gas monitoring as the disposals will not contain significant levels of organic compounds. The requirements for after care have been incorporated into the Environmental Monitoring Plan and Stewardship Plan to ensure consistency in management arrangements for the different environmental permitting regimes.

7.2 Habitat management arrangements

The following restoration activities will be undertaken across the site to prepare the landscape ahead of the IEP and manage it through the period between the IEP and SRS (Ref. 26).

Site wide

- Topography to replicate natural heathland landform, some bare ground features where possible. Natural colonisation will occur on very nutrient-poor soils, where an adjacent seed source is available;
- Maintenance of fire breaks (assumed maintenance access tracks will be sufficient, should additional breaks be required, these will need to be 'cut' into the vegetation);
- Annual cutting as required (June-August) using handheld cutters or similar;
- Control of undesirable/invasive species such as bracken (Pteridium aquilinum) conducted manually where possible. Use of chemical treatment will be reviewed and agreed prior to application.

Lowland heathland, valley mire

- Grazing annually (where possible) in summer to create variation in habitat structure and age of dwarf shrub species. Stocking density equivalent to around 0.5 cattle/ha;
- Scrub removal where required (November-February to avoid bird nesting season).

Lowland meadow, retained modified grassland and other neutral grassland

- Grazing annually (where possible) in summer to create variation in habitat structure. Stocking density equivalent to around 0.5 cattle/ha;
- Scrub removal where required (November-February to avoid bird nesting season).

Open mosaic habitat

- Minimal intervention, low intensity grazing annually in summer. Stocking density equivalent to around 0.5 cattle/ha;
- Scrub removal where required (November-February to avoid bird nesting season).

Planted Scrub

- Once scrub reaches maturity, periodic cutting shall be required to control its extent relative to adjacent habitats;
- Scrub removal where required (November-February to avoid bird nesting season).

Retained woodland

 Should tree works be required for health and safety reasons, an ecological survey to confirm the absence of any nesting bats/birds to be carried out before any works are conducted;



- Fallen leaves and branches to be left in-situ unless removal is otherwise instructed. Any logs/deadwood removed during management to be stored in piles in the woodland to create habitat;
- Any tree surgery works, or removal of vegetation shall be undertaken in accordance with the requirements of current published British Standard at time of works;
- Any necessary tree works will be carried out between November and February to avoid the bird nesting season.

Water management and grate clearing

Between the IEP and SRS, part of the northern part of the site will function as a natural valley mire, with the exception of the culvert draining surface water from the catchment under the railway line. During frequent rainfall events rainwater will either infiltrate into the soils or runoff overland towards the mire. It will then flow through the mire to the culvert. During flood events, water will attenuate in the mire and will discharge over a number of hours to prevent the downstream system from increased flows. For this system to function a grate will need to be placed on the culvert mouth to prevent blockage, and this will need to be monitored and cleared every 6 months to mitigate against flood risk.

Overview

The above activities will be reviewed and updated, and actions may need to be added, reduced, or amended to suit habitat succession and climate conditions. Key Performance Indicators (KPIs) will be used to track progress. Technical methods will be reviewed and adopted where appropriate, e.g. monitoring using spectral analysis of satellite imagery and/or environmental DNA sampling.

7.3 Environmental monitoring: disposal cap performance

The Dragon and SGHWR engineered caps play a key role in mitigating intrusion into the disposals below. Disturbance of the cap could lead to increased surface radiation doses and the subsequent spread of contamination. The radiological risk assessment shows that radiation doses arising from intrusion into the disposals will be well within regulatory thresholds given the low disposal inventory. However, periodic radiation dose assessment of the surface of the disposals will be undertaken for reassurance purposes.

The caps also have a function in minimising rainwater and surface water infiltration into the disposals and hence limit the potential for migration of contaminants (Ref. 39). Therefore, the performance of the caps is key to the performance of the disposals (Ref. 40, 41). The caps will be routinely monitored and checked to assess their topographic status. Monitoring will include 'surveillance', which is the visual inspection of the engineered caps to verify their integrity and detect changes, to provide reassurance and build confidence in the engineering. This will also provide the opportunity to identify any unexpected circumstances, such as animal intrusion, at an early stage.

Surveillance assessments would look for:

- Potential intrusions into the cap and the type of intrusion;
- Slumping of the cap(s) and the rate of settlement by comparison to the levels in previous surveys;
- Evidence that the cap drainage systems functionality may be altered;
- Potential impacts on the cap drainage systems, especially where the impact reduces drain effectiveness;
- Potential impacts on the cap and cap vegetation arising from visitor behaviour that may not have been considered in the disposal performance assessments and engineering specification for the caps.

In the period up to the site IEP, the level of disposal cap surveillance could be limited as the site would still be under NRS management and the site fence will continue to restrict access



(noting only Dragon will have a cap for a significant period). However, accidental intrusion might still occur, and burrowing animals and plant growth could disturb the surface or slumping and drain blockages could occur. Routine inspections, on a quarterly basis, will be carried out for the short period of time between the completion of the disposals through to the site IEP.

Once the site is publicly accessible, visual assessments of the caps will be completed up to the SRS. Visual evidence of intrusion into the disposals, either from humans by deliberate or accidental means, animals burrowing, or plant growth will be assessed on a routine basis. Visual assessment would take place in winter when weather events might lead to increased surface water impacts, and in summer when increased plant growth and visitor behaviour might impact the cap surface.

The methodology for cap monitoring has not yet been specified. Currently available methods include personnel walking over the caps making measurements and taking photographic/video evidence. However, more accurate and less intrusive technology, such as remotely piloted drones equipped with high-resolution cameras and remote sensing tools, may be available by the time disposals are made. In all cases, the assessments will look to identify any signs of intrusion, either by humans, animals, or plants, and identify signs of slumping or differential settlement that may indicate the cap or disposal is not performing as anticipated.

7.4 Environmental monitoring: groundwater monitoring

Before setting out the groundwater monitoring to support the Winfrith End State and proposed disposals, it is necessary to summarise the groundwater monitoring currently required under the current site environmental permit.

The Environmental Monitoring Programme required by the current Permit

The current environmental monitoring programme meets the requirements of the existing environmental permit, with specifics such as sample locations and sampling requirements (Ref. 42). Air, surface water, marine sediments, silt, and seaweed are sampled and analysed at specified locations, off-site, with the results reported routinely to the regulators. It is anticipated that most of the current sampling arrangements involving off-site measurements with some in the marine environment, should <u>not</u> be continued beyond the IEP, as the results of such analyses would not be indicators of how the disposals are performing or validate the restoration of the rest of the site.

Groundwater monitoring programme to support the Site End State

Groundwater monitoring will provide assurance the disposals are performing as anticipated, building confidence in the SWESC. It will also provide identify any unexpected circumstances at an early stage, so that recovery actions can be considered (Ref. 43).

The nature and type of monitoring undertaken is described within the Winfrith EMP. Monitoring will be targeted and limited, recognising the low level of risk from the disposals / deposits. The current groundwater monitoring provides a base line, which can be used when identifying changing behaviour. A radiological/non-radiological background has been completed that will form the main basis of the baseline (Ref. 6).

The Winfrith EMP describes the monitoring requirements once the disposals / deposits have been implemented at Dragon and SGHWR:

- A proposed reasoned and proportionate approach to monitoring the Winfrith site and its disposals / deposits;
- A programme for on-going radiological and non-radiological monitoring and assessment to provide evidence of compliance with the limits and conditions of the permit(s) and assurance of protection of members of the public and the environment;
- Demonstration that the parameters assessed are reflective of the SWESC, ESSD and underpinning risk assessments;



• Specific contaminant concentrations that would trigger further action.

The EMP sets out the justification for the:

- Required number and location of the monitoring boreholes;
- Sampling schedule;
- Radiological and non-radiological analytical suite;
- Details on how the results are to be managed;
- Trigger levels which lead to management action.

Not all boreholes currently on site are needed as part of the EMP. A number of those currently being used in the groundwater monitoring programme can continue to be used as part of validating the performance of the End States up to the SRS, whilst those not needed will be safely decommissioned as part of the zone close out process.

The boreholes will be secured and maintained to prevent public access. All boreholes will be locked to reduce the possibility for accidental or deliberate damage and borehole condition surveys undertaken when groundwater samples are taken.

Groundwater samples would be taken by a competent organisation working to a quality assured specification. They would also need to manage, number, store, and transport the samples to a contracted laboratory for analyses. The scope of monitoring in the EMP is set out in Table 4.

Monitoring	Parameters assessed	
Water Quality Sampling:	Gross alpha and beta	
Radiological Species	High Resolution gamma spectrometry' Tritium	
Water Quality Sampling: Non- radiological species	Field parameters: dissolved oxygen, temperature, redox conditions, pH, and electrical conductivity Metals (dissolved): As, Ba, Cd, Cr (total and Cr(VI)), Cu, Hg, Mo, Ni, Pb, Sb, Se, and Zn Major ions: Ca, Na, K, Mg, Cl, F, SO4, alkalinity	
Borehole Status Monitoring	Regular maintenance	
Cap Monitoring	Dose rate Walkover and photographic/video surveys Other topographic surveys e.g., remote sensing	

Table 4: Environmental Management Plan scope

The locations for boreholes to be assessed as part of the EMP are as follows:

- Up and down hydraulic gradient of the disposals / deposits at SGHWR and Dragon, to verify the performance of the disposals;
- Upgradient of the mire to understand any potential impact on receptors.

Monitoring has been undertaken for groundwater to provide a baseline of environmental concentrations and the historical impact of the operation of the reactors and their decommissioning. This will allow for an analysis of trends in groundwater quality following completion of disposals / deposits.

The boreholes that will be monitored are listed below:

- OW17 and OW18 upgradient of SGHWR;
- OW19, OW20, OW27 and OW28 immediately downgradient of SGHWR;
- OW22 and OW23 further downgradient of SGHWR and upgradient of Dragon and the mire receptor;
- OW131 and OW135 upgradient of Dragon;
- OW132, OW133, OW134 and BH411 downgradient of Dragon.

The locations of the groundwater monitoring points are shown in Figure 7.





Figure 7: Proposed groundwater monitoring locations.

Current land quality monitoring has resulted in an extensive network of boreholes available at Winfrith and in the event that the disposals/deposits do not perform as expected, these could be reactivated for additional monitoring purposes, prior to their being decommissioned.

7.5 Environmental monitoring results management

The permit holder, assumed to be NRS, or one of its suitably qualified contractors, would compile the environmental results, working to a strict quality assured specification. Data will be assessed, managed, stored, and interpreted in an open and transparent manner. The steps would include:

- Samples are collected on an agreed basis with the analysis results placed in the database;
- An approved and SQEP person within the permitted organisation would interpret the results and determine whether they support the End States performing as modelled, through a comparison of the results with agreed performance parameters. Any unexpected results and/or trends would be defined and investigated. This may involve repeat sampling;
- Where a judgement has been reached that the disposal has performed as modelled, then no further action is needed. The results and interpretation would be communicated to the EA;
- Where a change has taken place in one or more results, then this will lead to a recommendation for further assessment or action.

7.6 Where environmental monitoring results imply out-of-specification performance

A key function of stewardship is to provide reassurance that, if there are unexpected occurrences, then the issue is adequately assessed and remedial actions identified if required. Where required, remedial action would then need to be carried out in a timely manner.

Two capabilities are required to be able to identify out-of-specification performance: the capability to understand and interpret the implications of the unanticipated event, and the capability to do something about it if needed. Supplementing both actions is the need to retain the capability to maintain and update the SWESC. Figure 8 shows the decision-making associated with the performance assessment results.



The proposed process steps in Figure 8 are:

- If there is change in environmental monitoring information that suggests a change in circumstances, then determine if the change is significant;
- If the environmental impact is not significant then the site and disposals have performed within modelled scenarios in the permit variation case then no further action is required;
- If the environmental impact is significant but modelled performance is amenable to optimisation, then it should be optimised;
- If the environmental impact is significant but it is optimal to proceed without remediation, then the case for no action is made to the NDA and the EA to proceed without any action;
- If the environmental impact is significant and the optimal response is remediation, then the action is to remediate the situation to bring it back to within acceptable parameters.



Figure 8: Decision-making associated with the EMP results

7.7 Regulator, planning authority and stakeholder engagement arrangements The section is split into two phases: before the IEP and after the IEP through to the SRS.



Before the IEP

EA and DC: The current community and stakeholder engagement arrangements, with routine reporting against the current EPR permit, will be supplemented once the anticipated GRR and DfR permits are in place. Reporting against existing requirements in the current Permit (i.e. gaseous and aqueous discharges) will continue through this period. Additionally, routine reporting against the conditions of the new permits will start and continue up to the site's IEP, with any issues arising from the performance of the disposals at Dragon and SGHWR being managed under current regulator engagement arrangements.

The current stakeholder engagement arrangements (Ref. 44) that includes routine meetings with DC dealing with existing planning matters (Ref. 45), will continue up until the planning approval for the Winfrith End State is in place. Thereafter DC may want to continue the same arrangements with the added requirement to monitor planning conditions arising from the Winfrith End State planning application. In addition, there will be planning conditions arising from other site planning applications.

Public: Up to the site IEP, the main conduit for stakeholder engagement will continue to be through the Winfrith Site Stakeholder Group (WSSG) (Ref. 44). This would include reporting on implementation of the site End State and performance against the GRR and DfR permit conditions.

After the IEP

NRS will be responsible for identifying, communicating, and informing interested parties that stewardship controls remain on site after the IEP. A successful approach will provide interested parties with access to sufficient, easy to understand and up-to-date information, consistently for as long as the stewardship programme is required. The arrangements for this have not yet been identified as a wide range of interested parties will be engaged in how post-IEP engagement will be developed and implemented. It is anticipated that the new engagement arrangements will be set out and agreed as part of successfully achieving the IEP.

EA: The current engagement arrangements, with routine reporting against the current EPR permit, will change once the IEP has been achieved and there is no longer a permanent physical presence on site or any on-going discharges to the environment from gaseous or aqueous routes.

The arrangements for routine monitoring to demonstrate performance of the disposals with the GRR and DfR permits, and planning permission actions will need to be developed. It is anticipated that the engagement arrangements with the EA will be agreed ahead of achieving the IEP.

Public: The operation of the WSSG in the same manner as before the IEP, with frequent and regular face to face meetings, is not warranted or practicable once there is no longer a presence on the site. Public engagement on how the Winfrith End State is developing and performing, will continue to be open, ongoing, and two-way.

Engagement methods may be passive, requiring interested parties to 'pull' information from various sources, or proactive where information is 'pushed' to interested parties. It is likely both methods will be used.

Other examples of 'pull' methods of public engagement include registries, videos, public notices, the site archive, a site factsheet, and third-party data search services. Examples of 'push' methods include letters, community meetings, newsletters, and social media posts. Push events also provide an opportunity for NRS to collect information from interested parties.

The document record would include documents that formed the basis for the selection of the Winfrith End State e.g., a non-technical summary of the SWESC, public comments, and decisions.

NRS will attend periodic public meetings or participate in meetings instigated by others e.g. the local parish council and council environmental meetings. when there are clearly topics of interest to stakeholders concerning the site. These meetings will provide information about activities being conducted at Winfrith and the results of site inspections, monitoring, and any habitat and landscape maintenance undertaken as a result of visitor impacts. The meetings would also be informed of any disposal performance that was not predicted or modelled. The public might be asked to contribute to discussions on issues relating to the site, such as access control if protected species had been pressured by footfall.

It is expected that if there has been little of concern and there is widespread confidence in the evolution of the site, attending public meetings may not be required if the website postings ensure public communication is successful.

When the site approaches its SRS, it is expected that there would be increased stakeholder interest and further engagement ahead of seeking to surrender the remaining permit.

7.8 Preservation of knowledge and records up to and beyond the SRS

The GRR Requirement 6 states that operators shall manage and retain adequate records of their site's journey to completion of all planned work involving radioactive substances. Winfrith will provide these records in a form suitable for long-term preservation and access.

The EA emphasises the importance of records management, with the key need being to communicate knowledge about the site to future generations in an effective manner (Ref. 1), and that the arrangements reflect the GRR and DfR permit conditions and are in line with the management system. Interpreting the EA's guidance for the Winfrith End State leads to the need for the following key records being retained and accessible:

- As-built Dragon and SGHWR disposal designs and radiological and non-radiological inventories;
- Baseline environmental monitoring surveys;
- Environmental monitoring surveys carried out as part of the EMP;
- The SWESC and underpinning radiological and non-radiological assessments;
- Optimisation (Best Available Technique) assessment results;
- Records or regulatory and stakeholder interactions;
- The physical condition of the disposal surfaces relevant to environmental protection and radioactive waste management.

The site's approach to record management complies with the NDA's strategy on information governance (Ref. 46). With site ownership comes legal and regulatory responsibility for all of the information at Winfrith and the aim of the strategy is to ensure compliance with those responsibilities. Implementing the strategy, together with the delivery of the End State will encourage openness and transparency and ensure more effective collaboration and better communication with stakeholders.

The following sections identify the records management activities to support the Winfrith End State.

Collecting Information

The collection of data, its assessment for storage, and subsequent storage in the site's Geographical Information System (GIS) database will be the responsibility of the Winfrith site permit holder up to the site's IEP and by the organisation managing activities at Winfrith beyond the IEP and up to the SRS. Current record management arrangements for cataloguing, maintaining and access to records at Winfrith up to the site's IEP will continue as already carried out (Ref. 47). The arrangement beyond the IEP up to the SRS has yet to be agreed, however the location for records beyond the IEP will not be on site.

Records management needs to be comprehensive i.e., provide all the information that is likely to be required. However, it also needs to be selective. If everything is saved, without sufficient

organisation, then locating key information amongst the everyday detail will be a challenge. This means that it is necessary to assess each record and decide whether it needs to be retained and for how long (known as 'record appraisal').

A key component in how NRS manages its decommissioning, environmental and asset management data is through the Information Management and Geographical Evaluation System (IMAGES) GIS, a mapping technology that enables NRS to visualise, question, analyse, interpret, and understand historical information. It manages land quality characterisation data and informs decision-making and ensures long-term records are preserved about the Winfrith site into the future so they can be shared with others. This is in accordance with NRS procedures for record retention (Ref. 48).

Cataloguing the Records

A key requirement is that information is organised, so it is easy to find and is in context (by the records it is grouped with and the category/categories it is placed in). Each record will be described in detail so it can be found (by searching or browsing) and provide the context and background required to interpret it. This will include information required to understand the record if this information is not in the record itself. For example, for tables of monitoring data, descriptions relating to each data column and any codes used will be provided. This step is key to ensuring each record can be understood and correctly interpreted many years into the future, when those who created it are not around. Finally, an important practical need is to record the physical locations of records (for digital records their location within the storage system e.g. full path) so once a record has been found in the catalogue, it can be successfully retrieved from storage.

Maintaining the Records

Adequate record storage means protecting the physical records from physical damage by keeping them at the correct temperature and humidity and protected from sunlight, as well as protection from vermin and theft. The aim being for indefinite retention of much of the body of information necessary for a full description of the site.

Access to Records

It is assumed that site records will eventually be stored at the National Nuclear Archives (Ref. 49). There may need to be access controls on certain information. The policy on management of the original records will be important (e.g. whether people must work with copies). Records of the location of original sources of information will need to be clear.

Format of Records

As some file formats are more durable than others, those creating the records will need to take preservability into account. While physical records are easier to maintain (i.e. to ensure that they stay readable), they are less searchable and much bulkier. By contrast, digital records can be searched easily, take up far less space, but require much more maintenance. Ideally, the catalogue for both types of record will be combined, so that anyone searching for information on a specific Winfrith topic should only have to look in one place. Digital preservation presents more of a challenge, primarily because of the pace of technological change. To read a digital record (be that a word processing document, spreadsheet, CAD drawing, database of monitoring data) it will be necessary for there to be the appropriate:

- Software to read the format of the file(s) containing the record;
- Operating system that the software runs on;
- Hardware for the software.

As well as backing up the data and regularly refreshing the storage media, digital preservation seeks to tackle the problem of file format obsolescence. There are two main approaches used: migration and emulation. Migration is the periodic conversion of digital material from one

format to another, while emulation is the replication of hardware and/or software, including operating systems, to make it possible to view and use digital material in their original formats.

The IMAGES software is used for collating and compiling technical information and data associated with decommissioning, site characterisation, land quality management and site End State programmes. IMAGES is Oracle based and widely used across the nuclear industry and will provide assurance that End State records will remain available up to at least the SRS.

Whilst current record formatting arrangements will continue for the period up to the Winfrith IEP, agreement on formatting beyond the IEP will need to be defined.

7.9 Legal covenant management and availability

Covenants can be made that are time-limited and predicated upon the length of leases, or in perpetuity, to be preserved with deeds of land ownership. These are legal arrangements to protect access rights (e.g. wayleaves or easements) for maintenance, repairs, monitoring, and any future remedial works that may be needed, as well as to restrict the type and extent of physical change that can be made to the landscape.

Any legal covenants in place at Winfrith will be formally recorded and stored appropriately for as long as is required.

7.10 Maintaining technical capability

It is necessary to maintain the expertise to manage and interpret the results stemming from the stewardship phase. Many of the activities require specialist knowledge and experience. Key areas include monitoring and data interpretation, understanding engineering functions and environmental processes. Maintenance of the SWESC and environmental modelling will also be important. The issue of the availability of the nuclear skill required will need to be addressed to provide confidence that relevant skills are maintained through the planned period of stewardship. However, nuclear operations, including disposals, will continue in the UK far past the anticipated SRS for Winfrith, therefore there is a reasonable expectation that such a specialist resource will be available.

It is assumed that the NDA and NRS will need to demonstrate to the regulators and planning authority that there are sufficient skills to deliver the stewardship programme including maintenance of the SWESC.

7.11 Futureproofing the Stewardship Plan

The requirements, functions, and the range of actions that can be taken to address them, are informed by the site and regulatory context, and best practice and experience gained in the UK and elsewhere. It is expected that this plan will be updated where necessary. In defining the requirements the focus at this stage has been on the period between the IEP and the SRS. The current management arrangements for the site will, in the main, cover the period from the construction of the Dragon and then SGHWR disposals through to the IEP. For the purposes of the SWESC, it is assumed the period from the IEP to the SRS will last for a given period, assumed to be a number of decades.

Futureproofing the Stewardship Plan may include the following requirements:

- Making financial provision for continued monitoring and land management;
- Legal covenants to protect access rights for maintenance, repairs, monitoring, and any future remedial works that may be needed (e.g., maintenance of any remaining fencing, footpaths and ensuring the weir operates as specified), as well as to restrict the type and extent of physical change that can be made to the landscape;
- Adequate arrangements for environmental monitoring and landscape management measures and protection against the potential negative effects of extreme weather, including the impact of climate change. This will include enough competent support to

assess the results of the environmental monitoring and changes in landscape to be able to recommend where and when appropriate, remedial measures might be needed.

7.12 Arrangements after the SRS

After the SRS has been achieved, records describing the site will be finalised and stored in a transparent and accessible manner. The site would then revert to local planning development controls, although it is assumed in assessment calculations that such control would not prevent human intrusion. In practice, all the relevant records would be transferred at this time to an appropriate storage system. Any subsequent reuse of the site would require planning permission, and the former use of the site for radioactive waste disposal would be known by the local planning authority.

8 CONCLUSIONS

Public access to the restored Winfrith site will become available in the late 2030's after the decommissioning and demolition of the remaining structures on the site, the creation of the SGHWR and Dragon disposals / deposits, site restoration activities and landscaping has been completed. This point in time is known as the IEP.

The controls that will apply to the site from the creation of the SGHWR and Dragon disposals/ deposits through to the SRS have been drawn from the GRR requirements (Ref. 1) and from national and international experience. These controls will ensure the performance of the disposals and management of protected habitats.

The controls in place from disposal / deposit construction through to the IEP will be an adjunct to the ongoing site management arrangements. It is anticipated that the controls associated with the Dragon End State will start in the late 2020s, whilst the SGHWR End State disposal controls commence in the early 2030s. The existing management arrangements are then assumed to terminate at the IEP.

Control of the site will be maintained for the period beyond the IEP through to the SRS. This period is referred to as Stewardship. During that time, evidence will continue to be gathered to demonstrate the performance of the site, and particularly the disposals and how the landscape and habitats develop. This will be communicated to appropriate parties and last for an assumed period of ~30 years.

The Stewardship Plan seeks to comply with the environment agencies guidance set out in the GRR (Ref. 1) to demonstrate that the site has performed as modelled and in due course after a period of reassurance, can achieve its SRS and release from RSR. Additionally, the plan demonstrates appropriate after care for the permitted recovery operations and management of designated habitats. The Stewardship Plan set out in this document will deliver the following outcomes:

- Assure the regulators and stakeholders of the continued protection to people and the environment;
- Instil confidence among stakeholders and other parties regarding the management of the site up to the SRS;
- Provide a period of surveillance that will build confidence that the disposals / deposits perform as anticipated;
- Ensure the timely identification of any cap disturbance, e.g., from natural events or by inadvertent intrusion;
- Support the next planned land use that has been agreed with stakeholders;
- Provide evidence in due course to support the case to remove the regulatory controls enacted by the RSR permit at the SRS and the recovery permit.

The key components that will deliver the Winfrith End State will be the:

 EMP: the scope and extent of monitoring that will provide the assurance the disposals / deposits and land are safe;



- SWESC: the case that the disposals perform as modelled thereby providing the evidence that disposals / deposits and land are safe;
- RMP: how the Winfrith End State of heathland with public access develops to deliver the communities preferred land use.

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