Site Restoration

Winfrith End State:

Habitats Risk Assessment to support Environmental Permit applications for the Winfrith Site

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1 INTRODUCTION

1.1 Report Context

Nuclear Restoration Services (NRS) has prepared this Habitat Risk Assessment Report for inclusion in a Deposit for Recovery (DfR) bespoke environmental permit application for the recovery of waste at the Winfrith site, near Dorchester, Dorset.

The Winfrith site currently operates under a Nuclear Site Licence and Environmental Permit for Radioactive Substances Regulation (RSR). Current arrangements, management system and site rules are in compliance with the requirements set out in the extant licence and permit.

The application seeks to obtain an environmental permit for a Deposit for Recovery (DfR) activity to include the use of concrete blocks and demolition arisings (concrete and bricks) from demolition of the Steam Generating Heavy Water Reactor (SGHWR) and Dragon Reactors, and additional site stockpiles (as required). The purpose of the recovery activity is to backfill the reactor basements and voids, providing a surface level suitable for the next planned land use of Heathland with Public Access. Delivering the next planned land use is a core part of the mission for the Nuclear Decommissioning Authority (NDA) and NRS.

The end state for the SGHWR and Dragon structures is to backfill the below ground concrete basements with a combination of demolition materials that are radioactive (in-scope of RSR) and non-radioactive (out of scope of RSR).

Backfilling using non-radioactive demolition arisings is proposed to be undertaken under a bespoke environmental permit broadly along the lines of Standard Rules Permit No.39. This strategy of using a combination of radioactive and non-radioactive wastes in backfilling has been demonstrated to be optimised and minimise impact on local communities and habitats.

This report will serve to signpost the relevant sections and reports which demonstrate the safety of the proposed activity to the habitats surrounding the operation.

1.2 Proposed Activity

The Winfrith nuclear site is a former nuclear power research and development site, which housed research and prototype reactors as well as laboratories.

The site included nine experimental reactors in total, each with a unique design, with construction commencing in 1957 and the last operational reactor shut down in 1995. The site, owned by the NDA and operated by NRS, is currently being decommissioned.

The Site is undergoing decommissioning to remove hazards and complete the objective of reaching the defined end state. The Winfrith next planned land use is heathland with public access. The proposed end state for the site includes on-site disposals of the sub-surface SGHWR and Dragon reactor structures, with voids being filled using radioactive and non-radioactive demolition arisings. The proposal to dispose of radioactive wastes at the SGHWR and Dragon reactors will be subject to permission using the Environment Agencies Guidance on Requirements for Release from Radioactive Substances Regulation (known as the GRR). The disposals / deposits will be capped and landscaped to deliver the next planned land use.

1.3 Aim

NRS is applying for a single DfR permit to cover two deposits of demolition arisings in the below ground structures of the SGHWR and Dragon reactors on the Winfrith site. The deposits will be capped and landscaped.

This document will serve to summarise the output of the risk assessments relating to the designated habitats and non-human biota in proximity to proposed activities. The activity refers to the emplacement of the waste into the on-site disposals/deposits under GRR and DfR.

This document will summarise and signpost the risk assessments for the designated habitats and the environment.

1.4 Scope

The scope of this report is in relation to:

- Designated habitats identified as potential receptors for the proposed waste activities at SGHWR and Dragon;
- Risks from the completed disposals and deposits;
- A summary of the proposed mitigation measures to further minimise risks to habitats.

The potential risks have been assessed for the completed disposals / deposits, including inputs from recovered non-radioactive wastes, radioactive wastes disposals in-situ, radioactive wastes disposed for a purpose and non-radioactive materials remaining in-situ. This ensures that the totality of the environmental risk has been assessed, irrespective of the permissioning process.

Impacts and risks to habitats from implementation phase of wastes activities are assessed through the planning application process and supporting Environmental Impact Assessment. The mitigations and management of the risk to habitats is governed through the planning process and managed by the local authority (Dorset Council). For completeness an overview is presented in this document.

1.5 Planning Application

As has been documented throughout the pre-application engagement with the Environment Agency, the Winfrith Site does not have planning permission for the proposed activity at the time of Permit application.

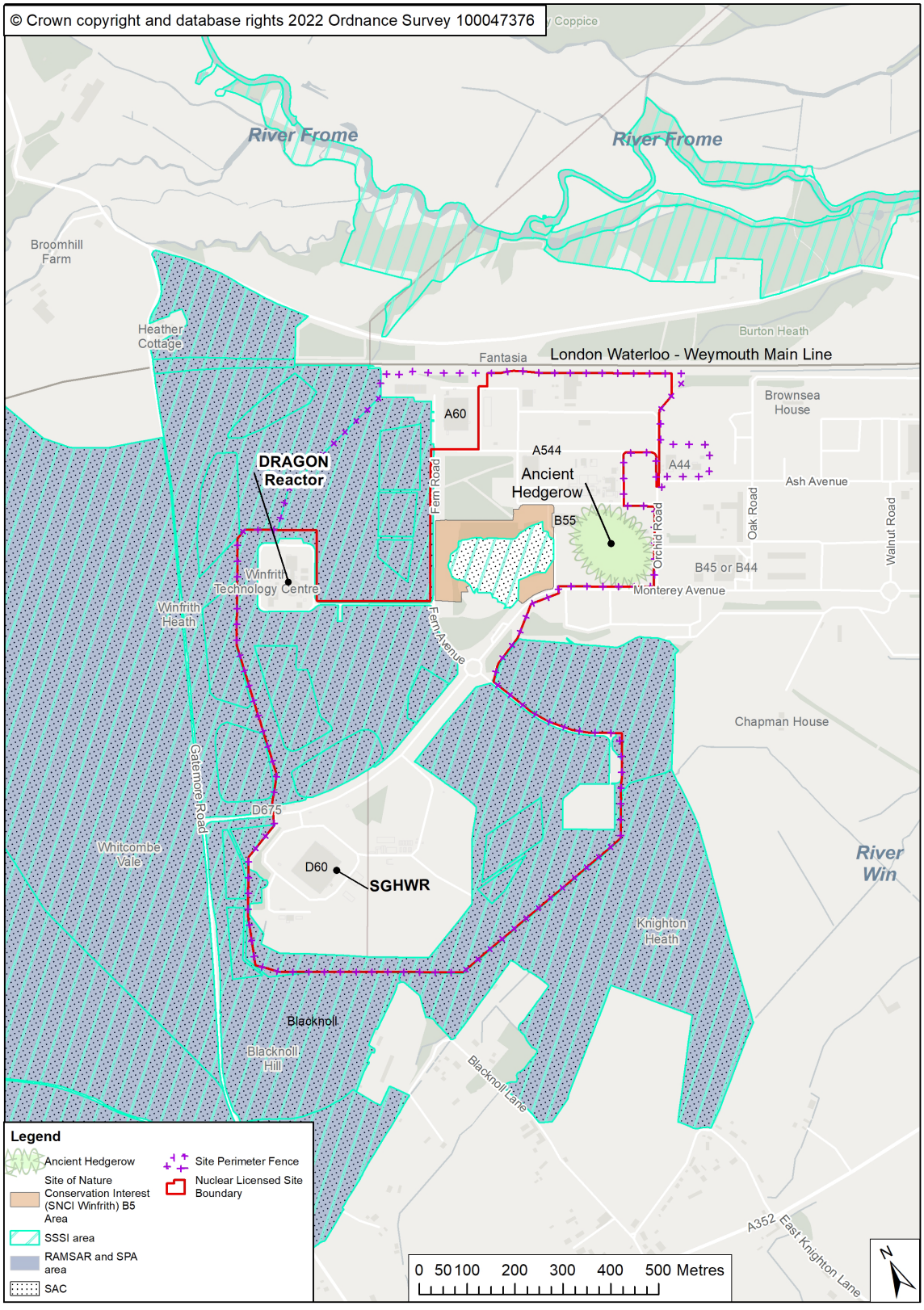
A planning application is to be submitted to Dorset Council for the final decommissioning, demolition and restoration of the Winfrith Site during 2025. As part of this planning application, a shadow Habitats Regulations Assessment has been prepared for the specified activities with input from Natural England.

2 WINFRITH SITE HABITAT DESIGNATIONS

Most of the NRS Winfrith site is located within the Winfrith Heath Site of Special Scientific Interest (SSSI), although the areas around the SGHWR and Dragon reactors are excluded (Figure 1), along with the more developed land on the northern site boundary.

This SSSI includes both the Winfrith Heath and Tadnoll Nature Reserves and is also designated as the Dorset Heath Special Area of Conservation (SAC), the Dorset Heathlands Special Protection Area (SPA) and the Dorset Heathland Ramsar site.

Figure 1: Location of Winfrith Heath SSSI and River Frome SSSI, SAC, SPA and Ramsar habitat designations.



2.1 Winfrith Heath SSSI

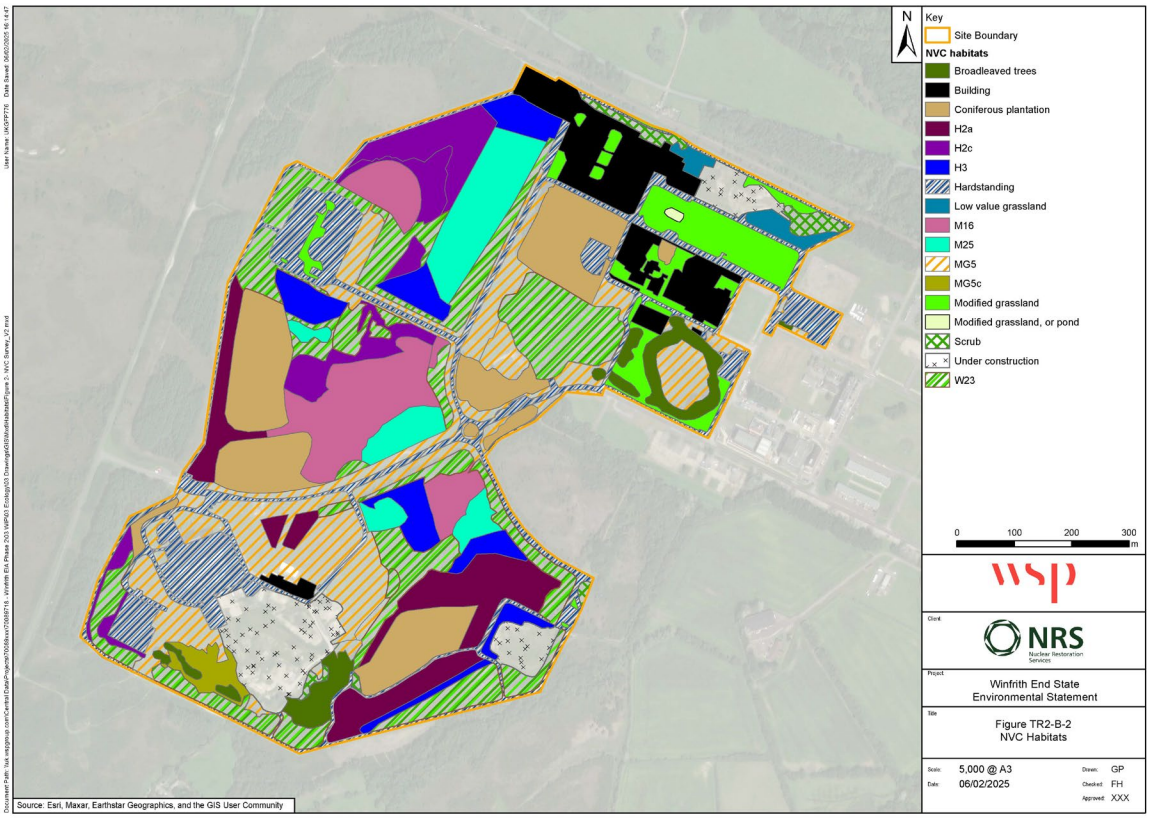
The Winfrith Heath SSSI is a substantial and varied tract of heathland near the western limit of the Dorset Heaths. It encompasses a range of heath and mire ecological communities on the sides of the Tadnoll Brook and in the wet pastureland of the valley floor. The ecological habitats across the site have been assessed using the National Vegetation Classification (NVC) scheme as shown in Figure 2. Within the designated parts of the site (i.e., those that are within the Winfrith Heath SSSI), there are three principal plant communities relating to the designations, types H2, H3 and M16, which have the following characteristics (Ref. 1):

- Ulex minor heath (H2): A lowland dry heath community that occurs on dry acid soils;
- Agrostis curtisii heath (H3): This is a transitional habitat between lowland dry heaths and wetter mire communities;
- Sphagnum compactum wet heath (M16): Wet heath usually occurs on acidic, nutrient-poor substrates, such as shallow peats or sandy soils with impeded drainage.

All three are associated with low pH values, with M16 preferring wetter (seasonally waterlogged/flooded) conditions than H3 (moist) and H2 (dry) (Ref. 2).

The three communities (H2, H3 and H16) are all qualifying features, which are the primary features for the designation of the Dorset Heaths SAC (Ref. 2).

Figure 2: Spatial Distribution of NVC Communities at Winfrith



2.2 River Frome SSSI

The River Frome and adjacent land forms a separate SSSI to the north of the site. The River Frome is the most westerly example of a major chalk stream in England with species-rich aquatic and bankside vegetation (Ref. 3).

Whilst not on the NRS Winfrith Site, the River Frome has been demonstrated to be a downgradient receptor of groundwater which flows from beneath the Dragon Reactor, and in

some environmental conditions from the SGHWR (Ref. 4). For this reason, the River Frome SSSI has been included in risk assessments.

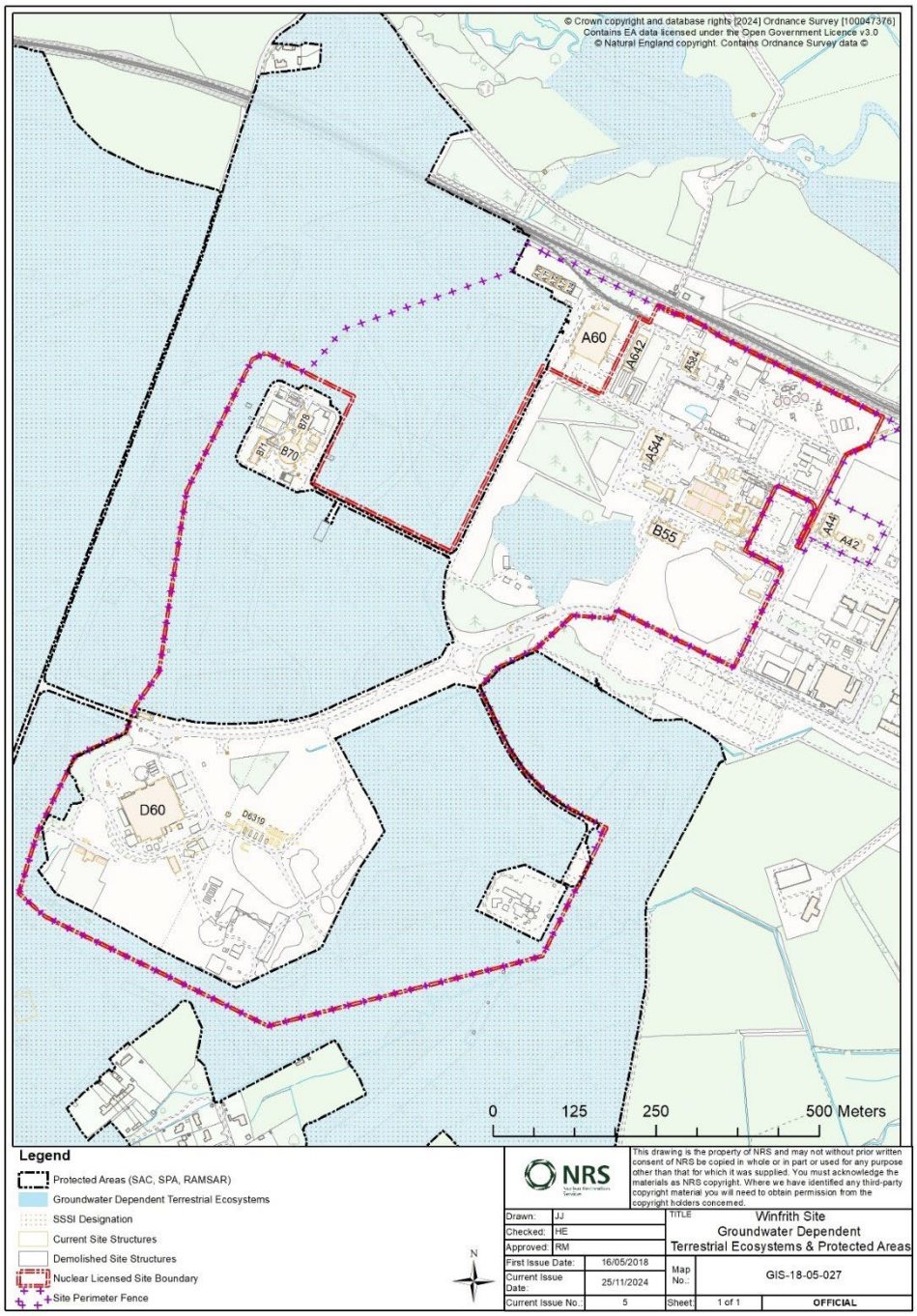
2.3 Groundwater Dependent Terrestrial Ecosystems (GWDTE's)

Large portions of the Winfrith site also sit within designated Groundwater Dependent Terrestrial Ecosystems (GWDTEs).

The GWDTEs designation is used for wetland areas that are dependent on the groundwater. These ecosystems need to be assessed to ensure that the groundwater has not been significantly altered, leading to damage to habitats. The location of the GWDTEs on the Winfrith site are shown in Figure 3.

GWDTEs form the immediate vicinity around the proposed Dragon DfR operation, however do not border SGHWR. Nonetheless, the GWDTE do form downgradient receptors for SGHWR and therefore requires consideration.

Figure 3: The location of GWDTEs on the Winfrith Site (Ref. 5)



3 APPROACH TO RISK ASSESSMENT

To appropriately characterise the risk to habitats from the activity, a series of underpinning inventories and assessments have been developed. In order to adequately inform the risk assessments, both a radiological (Ref. 6) and non-radiological inventory (Ref. 7) have been prepared from design drawings and characterisation data for the SGHWR and Dragon structures and proposed backfill materials.

The purpose of the non-radiological inventory is to present a cautious quantification of the mass, volume and concentration of the non-radiological material and contaminants that will remain in situ or be emplaced into the on-site disposal/deposits. The non-radiological inventory

provides a detailed underpinning of the Hydrogeological Risk Assessment (Ref. 4) and associated modelling.

The radiological inventory (Ref. 6) presents a cautious assessment of the radioactivity remaining within the disposals once complete. The inventory characterises the estimated total radiological activity remaining within the structures and the detailed understanding of individual features determined through detailed characterisation. The radiological inventory serves to provide a detailed underpinning to the associated risk assessments. The radiological risk assessment (Ref. 8), termed a Radiological Performance Assessment, is a detailed assessment of potential risks from a wide variety of scenarios, including natural evolution of the disposals over 100's to 1000's of years.

The hydrological and hydrogeological environment of the disposals and the surround site have been assessed and are presented in the Conceptual Site Model (CSM) (Ref. 11). The effect of climate change on groundwater levels, and the potential impact that this will have on the disposals, is assessed within the climate change assessment (Ref. 12) reviewing potential scenarios up to 2099. The groundwater pathway has been assessed to discharge from SGHWR to the south of Monterrey roundabout, and from Dragon to discharge at surface in low lying land surrounding the River Frome. The CSM (Ref. 11) establishes how contaminants defined in the inventories for the SGHWR and Dragon disposals / deposits will move and interact with the environment and habitats.

The risk assessment process has assessed the totality of the non-radiological risk to the environment and habitats and is documented in the Hydrogeological Risk Assessment (Ref. 4). The assessment of pH presented in the HRA provides a detailed numerical interpretation of the risks presented in the hydroecology assessment (Ref. 2).

The hydroecology assessment considers the sensitivity of the SSSI, GWDTE and SAC habitats on the Winfrith Site to variations in pH and groundwater levels. Through collating the modelled changes in pH (Ref. 4) from the disposals / deposits, and assessing the sensitivity of the habitats (Ref. 2), the risk to habitats from variations in pH has been assessed.

An assessment of the radiological risk to non-human biota (Ref. 8) under a variety of different scenarios is provided in the Radiological Performance Assessment. The risks from the individual disposals and from the totality of the site are assessed and presented.

4 HYDROGEOLOGICAL RISK ASSESMENT

Since the Winfrith Heath SSSI and GWDTE's are the principal downgradient receptors of the SGHWR and Dragon disposals, protection of these features is of primary importance (Ref. 4) in assessment of risks.

A Hydrogeological Risk Assessment (Ref. 4) has been prepared for the disposals/deposits (Ref. 4). The Hydrogeological Risk Assessment considers the impact of the disposal / deposit once the waste is emplaced and capped and assesses the risks to the environment from the disposals / deposits interacting with the environment.

Risks from implementation are assessed through the Environmental Impact Assessment and shadow Habitats Regulations Assessment provided with the planning application.

The Hydrogeological Risk Assessment followed a tiered approach, as set out in the EA guidance (Ref. 15) so that more detailed assessments are undertaken where the risk to groundwater and thus habitats, is greatest. The three tiers of the assessment are:

- Tier 1: Qualitative Risk Screening;
- Tier 2: Generic Quantitative Risk Assessment (GQRA); and
- Tier 3: Detailed Quantitative Risk Assessment (DQRA).

4.1 Qualitative Risk Screening

Concrete is common below the water table across the UK, in features such as slabs, and building foundations. These features are commonly left in situ following demolition works and are not identified as having a detrimental impact on groundwater quality when left in-situ. Through extensive groundwater monitoring around the SGHWR reactor, there has been no evidence that the concrete structures are affecting groundwater quality. Consequently, in-situ concrete is not anticipated to have a detrimental impact on groundwater and therefore was not assessed further in the risk assessment process (Ref. 4).

Structural steels and rebar present in concrete structures corrode at low rates releasing iron. The iron is expected to be precipitated in the unsaturated zone or groundwater due to the oxygenated environment identified in groundwater monitoring. Therefore there is no risk of metals impacting groundwater and habitats surrounding the disposals / deposits. Metals have not been assessed further as being demonstrably shown as no discernible risk to groundwater, and thus no discernible risk to habitats (Ref. 4).

The potential risk for the following contaminants was assessed as acceptable and therefore require no further tiers of risk assessment (Ref. 4):

- Contaminants bound within concrete in reinforced concrete structures, concrete blocks and the Dragon reactor mortuary holes monolith. This is with the exception of the hydroxide ion (which can generate high pH when concrete interacts with water) leached from the concrete blocks;
- Structural steel and rebar in concrete structures and blocks;
- Paint;
- Fibreglass;
- <C10 aromatic compounds, >C16 aliphatic compounds and all PAH-16 species in Localised Oil Staining identified in SGHWR below ground structures);
- Arsenic; and
- Mercury.

Many of theses contaminants are identified at very low levels in the inventory, commonly at or below levels naturally present in the local environment, therefore the potential risk to the local environment is very low.

4.2 Generic Quantitative Risk Assessment

Chemical contaminants not screened in the Tier 1 qualitative assessment are subject to more detailed calculations at the GQRA stage. The porewater concentrations of contaminants in the demolition arisings have been calculated and compared with the compliance criteria, as required by a Tier 2 GQRA (Ref. 13). The calculated concentrations are compared to compliance criteria derived from relevant environmental protection criteria (Ref. 15).

Calculated porewater concentrations for the following contaminants are below their respective compliance criteria (Ref. 7), and as such are not assessed further:

- Antimony;
- Barium;
- Cadmium;
- Chloride;
- Fluoride;
- Molybdenum;
- Nickel;
- Selenium; and
- Sulphate.

Therefore the contaminants do not pose excessive risk to groundwater or surrounding designated habitats.

The GQRA has demonstrated that the contaminants presented in Table 1 require a more detailed assessment in a Tier 3 DQRA.

4.3 Detailed Quantitative Risk Assessment

DQRA modelling of the components of the SGHWR and Dragon deposits / disposals has demonstrated that the risk for all modelled contaminants is acceptable. At the DQRA stage, modelling is used to assess how any contaminants not screened at Tier 1 and 2 will interact with the environment are assessed and compared to compliance criteria. Table 1 identifies the components and resultant contaminants assessed at the Tier 3 stage.

Table 1: Summary of Components and Contaminants Requiring Tier 3 DQRA

Component in SGHWR and Dragon Reactors End State	**Contaminant**
Concrete Blocks	Alkalinity (pH)
Demolition Arisings	Alkalinity (pH) Chromium (as Cr(III) and Cr(VI), copper, lead, and zinc PCB-28, PCB-52, PCB-101, PCB-118, PCB-118, PCB-138, PCB-153 and PCB-180
Oil Stained Concrete (SGHWR Regions 1 and 2 Only)	TPH-CWG >C10-C12, >C12-C16 and >C16-C21 aromatic fractions

Modelling of contaminant behaviours in the environment has demonstrated that the risk to groundwater and habitats for all modelled contaminants is below relevant environmental standards and therefore acceptable. Furthermore the Tier 3 DQRA assessment has concluded that the cumulative impacts from SGHWR and Dragon will not cause an unacceptable risk to groundwater (Ref. 4).

Based on the three tiers of risk assessment, it is concluded that the non-radiological hydrogeological risk to habitats from disposals / deposits is acceptable. Outputs of the numerical modelling compared to compliance limits are presented in the Hydrogeological Risk Assessment (Ref. 4).

5 HYDROECOLOGICAL ASSESSMENT

An assessment of habitats at the Winfrith site was undertaken (Ref. 2) to define the sensitivity of the habitats to groundwater levels and pH. The qualifying vegetation features for the Winfrith Heath SAC are presented in Table 2.

Table 2: Qualitative assessment of hydrological and water quality requirements of habitats at the Winfrith Site (Ref.).

Habitat Type	NVC Community	Description	Flooding	pH
Mire	M16 Erica tetralix – Sphagnum compactum	At least seasonally waterlogged but not all year round. Can be intermittently dry during summer.	Tolerant of some flooding	Acidic soils
Heath	H2 Calluna vulgaris – Ulex minor heath	Free draining- no waterlogging	Intolerant of flooding	Acidic soils
	H3 Ulex minor – Agrostis curtisii	Associated with drainage impedance, free drainage but moist		

5.1 Alkalinity

Given the relatively rare nature of the acidic heath habitats identified on the Winfrith site, additional studies have been completed to define the potential risks to the habitat from alkalinity. Whilst the Dorset Heaths SAC is a large spatial area, the area of risk from the disposals / deposits is only the zone of emergence of groundwater that has passed by SGHWR and Dragon Reactors and acquired hydroxide ions. The presence of hydroxide ions could result in increasing alkalinity (raising the pH) and impacting the habitats.

With the exception of *Sphagnum (M16)*, the plant communities included within the SAC designation (H2 Ulex minor heath and H3 Agrostis curtisii) of wet mire and heathland are unlikely to be tolerant to alkalinity changes (Ref. 2).

M16 and H2 habitat communities have a documented pH range of 3.5 to 4.5 for favourable conditions. Increases in pH (>5) may lead to subtle variations in the composition of communities; however the communities would remain consistent with the SAC designation (Ref. 2) and therefore the risk to the SAC designation is low.

Further increases in pH towards neutral conditions (pH 7) due to alkaline porewaters interacting with the root zone of the acid soil would cause a reduction of the qualifying features of the SAC in these areas. A neutral pH would permit the development of non-qualifying feature habitats causing detrimental impacts to the SAC communities (Ref. 2).

The presence of alkaline forming hydroxide ions in groundwater may not cause any detrimental impact to habitats if remaining at depth (i.e. not interacting with the root zone). The impact on vegetation will only affect the rootzone, and therefore habitats, where groundwater is present approximately 0.2 m below ground level (Ref. 2). Therefore the receptor location is where groundwater interacts with the rootzone.

Modelled groundwater pH concentrations at the Dragon compliance point is pH 5.70 (Ref. 4) in comparison to a compliance limit of pH 7. The compliance point is 50 m downgradient of the Dragon reactor however this location does not represent a receptor habitat. As such, there is no risk with respect to alkalinity on habitats even further from the Dragon disposal / deposit such as the River Frome SSSI and GWDTEs.

Modelled pH arising from the SGHWR disposal / deposit is pH 9.33 at the compliance point (50m downgradient of SGHWR). Whilst the pH of groundwater immediately downgradient of SGHWR is alkaline, this groundwater does not immediately discharge to the root zone of the qualifying features of the SAC and SSSI.

Environment Agency guidance (Ref. 7) allows concentrations greater than compliance limits at the compliance point, where the receptor is located downgradient and attenuation may occur. Modelled alkalinity at a distance 500m downgradient of SGHWR (the mire receptor) is pH 6.35 and therefore below the compliance limit of pH 7. Consequently, it has been assessed that the modelled pH change of groundwater at the receptor (mire) downgradient of SGHWR.

Consequently, the M16 wet heath should be resilient to the modest increases in pH at the downgradient receptor from the SGHWR disposal.

6 ASSESSMENT OF RADIOLOGICAL RISK TO HABITATS

The 'Environmental Risk from Ionising Contaminants: Assessment and Management' ERICA methodology is an internationally recognised approach to assessing the risks to non-human biota from radioactivity. ERICA has been used to determine the dose effects to non-human biota resulting from aqueous releases from the proposed on-site disposals. The ERICA methodology calculates dose rates to organisms using radionuclide concentration values in environmental media (Ref. 8).

As with the non-radiological risk assessment (Section 4), a detailed and cautious radiological inventory has been calculated to support the assessment. The radiological inventory calculates a 'reference' inventory as a cautious assessment of the radioactivity remaining as part of the proposed disposals. In addition, an alternative inventory has been calculated to test the resilience of the risk assessments. The alternative inventories are pessimistic and not a realistic representation of the radioactivity remaining as part of the disposals.

The CSM is used (Ref. 11) to assess how this inventory may move in the local environment for a range of conditions.

6.1 ERICA Tiered Screening Assessment

As with the non-radiological assessment, the ERICA assessment is tiered, with more detailed calculations completed where the initial phases indicate risks require further assessment. The tiers are as follows:

- Tier 1: Risk Screening;
- Tier 2: Generic Quantitative; and
- Tier 3: Detailed Quantitative Assessment.

Tier 1 is a high-level screening which applies simplified but conservative assumptions. This is aimed at distinguishing areas or receptors of negligible concern and do not require further assessments. Tiers 2 and 3 allow more user-defined options (including the addition of isotopes to the default list) and the use of site-specific data, where available.

The assessment for the proposed disposals is presented in the Site Wide Environmental Safety Case (SWESC) (Ref. 12) and supporting assessments.

The ERICA Tier 1 Assessment is a course screen that includes only some radionuclides. Some of the radionuclides in the Winfrith radiological inventory are not present in the ERICA Tier 1 tool. Therefore, to ensure that the assessment sufficiently reflects the Winfrith disposals, assessments started at Tier 2, with Tier 1 omitted (Ref. 8).

The ERICA default screening level (10 μGy h^{-1}) is the most conservative approach to assessment and has been used as a benchmark dose value.

6.2 ERICA Assessment Results

Results of the ERICA assessment are presented in the Radiological Performance Assessment (Ref. 8). Assessments have been undertaken for the soil, the mire and the River Frome.

In all assessments, the results show doses to all potential receptors to be below the most conservative screening criteria, and therefore meeting all compliance requirements.

6.2.1 Field (Soil) Compartment

A terrestrial Tier 2 assessment was undertaken using the peak soil concentrations in the Field compartment (soil). Dose rates for both the reference and alternative inventories for all organisms are well below the default ERICA dose rate screening criterion of 10 µGy h^{-1}.

The Tier 2 screening level is not exceeded, the risk to non-human biota can be considered to be trivial, and no further assessment is required (Ref. 8).

The results demonstrating that no further assessment is required are presented in Table 3.

Table 3: Total dose rates per organism for the Field Compartment of the Winfrith biosphere (Ref. 8)

Organism	Reference Inventory	Alternative Inventory
	Dose Rate (µGy/h)	Dose Rate (µGy/h)
Amphibian	5.51E-06	1.88E-05
Bird	2.12E-06	9.12E-06
Mollusc- gastropod	2.73E-06	1.25E-05
Reptile	5.44E-06	2.81E-05
Annelid	6.83E-06	3.59E-05
Arthropod- detritivorous	8.84E-06	4.45E-05
Flying Insects	2.23E-06	1.13E-05
Grasses & Herbs	7.72E-06	3.58E-05
Lichen & Bryophytes	4.63E-05	2.18E-04
Mammals- large	3.16E-06	1.48E-05
Mammals- small, burrowing	3.24E-06	1.53E-05
Shrub	9.56E-06	4.92E-05
Tree	1.78E-06	7.00E-06

6.2.2 Land (Mire) Compartment

Two Tier 2 assessments, one for a terrestrial ecosystem and one for a freshwater ecosystem, were completed using the peak water and soil/sediment concentrations in the Land/Mire compartment (Ref. 8).

In all cases (whether modelled as a freshwater or terrestrial ecosystem) for both reference and alternative inventories, the dose rates are below the ERICA dose rate screening criterion of 10 µGy h^{-1}. Consequently, the Tier 2 screening level is not exceeded, the risk to non-human biota can be considered to be negligible, and no further assessment is required (Ref. 8).

The results for the ERICA assessment of the Land (Mire) compartment are presented in Tables 4 and 5.

Table 4: Total dose rates per organism for the Land (Mire) Compartment of the Winfrith biosphere, modelled as a freshwater ecosystem (Ref. 8)

Organism	Reference Inventory	Alternative Inventory
	Dose Rate (µGy/h)	Dose Rate (µGy/h)
Amphibian	2.47E-02	1.17E-01
Benthic fish	3.62E-02	9.44E-02
Bird	4.10E-02	1.82E-01
Crustacean	6.71E-02	2.50E-01
Insect larvae	4.92E-01	1.93E+00
Mammal	3.05E-02	9.37E-02
Mollusc – bivalve	4.99E-01	1.84E+00
Mollusc – gastropod	3.94E-01	1.57E+00
Pelagic fish	3.57E-02	9.23E-02
Phytoplankton	2.27E-02	9.21E-02
Reptile	5.11E-02	1.66E-01
Vascular plant	8.06E-02	2.77E-01
Zooplankton	4.04E-01	1.62E+00

Table 5: Total dose rates per organism for the Land (Mire) Compartment of the Winfrith biosphere, modelled as a terrestrial ecosystem (Ref. 8)

Organism	Reference Inventory	Alternative Inventory
	Dose Rate (µGy/h)	Dose Rate (µGy/h)
Amphibian	2.31E-03	1.21E-02
Benthic fish	7.24E-04	3.29E-03
Bird	1.50E-03	5.09E-03
Crustacean	2.28E-03	1.18E-02
Insect larvae	3.43E-03	1.63E-02
Mammal	4.86E-03	2.02E-02
Mollusc – bivalve	9.74E-04	4.52E-03
Mollusc – gastropod	4.24E-03	1.47E-02
Pelagic fish	2.96E-02	9.69E-02
Phytoplankton	1.22E-03	5.89E-03
Reptile	1.25E-03	6.10E-03
Vascular plant	4.69E-03	2.17E-02
Zooplankton	5.86E-04	2.31E-03

6.2.3 River Frome Compartment

A Tier 2 assessment was undertaken using the modelled peak water and sediment concentrations in the River Frome compartment. Dose rates for both the reference and alternative inventories for all organisms are well below the default ERICA dose rate screening criterion of 10 µGy h^{-1}.

The Tier 2 screening level is not exceeded, the risk to non-human biota can be considered to be trivial, and no further assessment is required (Ref. 8).

The results demonstrating that no further assessment is required are presented in Table 6.

Table 6: Total dose rates per organism for the River (River Frome) Compartment of the Winfrith biosphere (Ref. 8)

Organism	Reference Inventory	Alternative Inventory
	Dose Rate (µGy/h)	Dose Rate (µGy/h)
Amphibian	2.31E-04	1.14E-03
Benthic fish	2.61E-04	7.78E-04
Bird	3.42E-04	1.62E-03
Crustacean	7.16E-04	3.24E-03
Insect larvae	3.93E-03	1.70E-02
Mammal	2.50E-04	9.12E-04
Mollusc – bivalve	3.90E-03	1.61E-02
Mollusc – gastropod	3.11E-03	1.37E-02
Pelagic fish	2.56E-04	7.57E-04
Phytoplankton	2.34E-04	1.14E-03
Reptile	3.96E-04	1.47E-03
Vascular plant	8.03E-04	3.66E-03
Zooplankton	3.28E-03	1.47E-02

7 MITIGATIONS FOR PERMITTED ACTIVITIES

As demonstrated through the conservatively modelled risk assessments (Ref. 2, 4, 8 and 12), the unmitigated risks from the deposits / disposals is low and within compliance limits. Nonetheless the lifetime risks of the deposits / disposals to sensitive habitats are further reduced through engineering controls (Ref. 12), including:

- Engineered caps to reduce infiltration of rainwater to the waste and prevent unintended excavation from humans, animals or plant roots into the waste;
- Sealing of penetrations that would lead to a direct discharge to groundwater; and
- Strategic emplacement of large concrete blocks in areas of the deposits / disposals to reduce leaching of contaminants (including hydroxide ions), thereby reducing the concentrations of potential source term contaminants.

8 MITIGATIONS DURING IMPLEMENTATION PHASE

A Construction Environmental Management Plan (CEMP) (Ref. 10) has been prepared and submitted to the EA in support of the DfR application. The CEMP is essential during the operation to ensure that environmental controls are implemented to meet environmental legislation. The CEMP will ensure that:

- Environmental management, controls, and safety procedures for the implementation are in place. This will ensure that relevant mitigations are implemented to minimise potential impact on the environment wherever possible;

- Ensure that all enabling, demolition and implementation works cause minimal disruption to the community and environmental receptors; and
- All legislation, standards, industry codes of practice, and good practices are implemented.

A detailed list of all mitigation measures and their drivers are presented in the CEMP (Ref. 10).

The potential effects from implementing the site end state, including the proposed on-site disposals / deposits, on habitats have been assessed. The controls and measures identified in the CEMP will provide appropriate protection of these sensitive receptors to minimise any potentially significant impacts from implementation.

8.1 Potential Impacts on Habitats from Implementation of disposals

Using Natural England's assessment of the habitats on the site (Ref. 1), the potential impacts of implementing the two disposals/deposits has been considered and assessed.

The assessments show the potential for effects on the Dorset Heaths SAC and Dorset Heathlands Ramsar. The potential effects are:

Dorset Heaths SAC:

- Airborne pollution from implementation of disposals; and
- Hydrology and Water Quality from the implementation phase.

Dorset Heathlands RAMSAR:

- Airborne pollution; and
- Hydrology and Water Quality from the implementation phase.

A full Habitats Regulation Assessment for implementation of the site end state, including on-site disposal / deposit and wider restoration works, will be provided with the planning application to be supplied to the Dorset Council, acting as the relevant authority. A summary of the outputs is provided here for completeness.

8.2 Airborne Pollution

Airborne pollution from dust escaping beyond the site boundary is a potential source of statutory nuisance. Airborne pollution from dust is a risk to both on-site and nearby terrestrial and aquatic habitats.

The sources and pathways of airborne pollution are presented in the CEMP (Ref. 10). These sources include: dust entrainment from stockpiles, operations across the site and excavations amongst others.

To provide appropriate protection and avoid airborne pollution a series of management measures have been specified in the CEMP (Ref. 10). These management measures are to be implemented to reduce to potential for significant dust generation and fallout onto sensitive habitats through the implementation of the on-site disposals and wider site restoration works.

Ongoing monitoring during the implementation of the project will be undertaken to ensure the success of these management controls, with monitoring requirements presented in the CEMP (Ref. 10)).

8.3 Hydrology and Water Quality

There is a risk that during the works substances, such as silt, could become entrained in surface water flows and be discharged to the River Frome, resulting in a pollution event. Furthermore, groundwater flows are susceptible to pollution via the release of contaminating substances to ground, or the mobilisation of existing contaminants into ground water.

There is a risk that, during construction of the disposals, contaminants or silts may be entrained in groundwater at SGHWR and discharge at the downgradient GWDTE, or from Dragon and discharge in the River Frome SSSI and wetlands.

To provide appropriate protection and avoid detrimental impacts to surface and ground waters, a series of management measures have been specified in the CEMP (Ref. 10). These are primarily associated with the wider site restoration activities, as the overall risks from proposed on-site disposals / deposits is minimal.

Ongoing groundwater monitoring will be undertaken during the implementation of the project to ensure the success of these management controls, with monitoring requirements presented in the Environmental Monitoring Plan (Ref. 14).

9 CONCLUSIONS

The Winfrith site has a number of designated habitats that require a more detailed assessment of potential risks from the proposed on-site disposals / deposits. These include SSSI, SAC, SPA, Ramsar and GWDTE's and are defined as the sensitive receptors for the proposed disposals / deposits.

Risk assessments have been completed for the proposed disposals / deposits that are subject to Environmental Permit applications. The risk assessments demonstrate that the unmitigated risks to the habitats on, and in proximity to, the Winfrith site are low and within relevant standards. Mitigations and management controls have been specified to ensure the risks are as low as reasonably achievable.

Numerical modelling undertaken for the Hydrogeological Risk Assessment has assessed the risk from the chemical components that will make up the SGHWR and Dragon disposals / deposits. The Hydrogeological Risk Assessment assessed the risk from any chemicals (including pH) in the disposals / deposits that may enter the environment under a wider range of conditions, including climate change scenarios. The Hydrogeological Risk Assessment demonstrates that:

- Chemical components of the concrete including metals and other trace contaminants meet relevant environmental standards at compliance points and / or receptor locations;
- Groundwater pH conditions at the compliance point downgradient of Dragon remain acidic and therefore consistent with the local environmental conditions.
- Groundwaters at the compliance point 50m downgradient of SGHWR are modelled to be alkaline. However, attenuation in the geosphere shows that pH levels are modelled to be acidic when they reach the environmental receptor (rootzone of designated habitats). Therefore, alkalinity arising from the disposals / deposits will not impact the designated habitats and is acceptable to the groundwater dependent terrestrial ecosystems (Ref. 9).

The potential radiological impacts on the environment as modelled in the ERICA assessment (Ref. 8) are several orders of magnitude below the 10 μGy hr^{-1} dose rate screening criteria in all modelled compartments (Field, Land and River).

As demonstrated through the risk assessments for the long-term environmental performance of the disposals / deposits, the unmitigated risk to the sensitive receptors is low. The risks will be further reduced through engineering and construction controls (Ref. 10) including: capping activities, sealing of penetrations and the emplacement of large concrete blocks rather than demolition arisings.

Through the implemented mitigations and management controls, it is not anticipated that there will be any detrimental impact to the sensitive receptors through the implementation of the disposals / deposits. The mitigations and controls which NRS will implement through the demolition, emplacement of the waste and capping activities are presented in the CEMP (Ref. 10).

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