Winfrith End State:

Environmental Setting and Site Description Report

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QA Grade: 1

Review/Revision Register

A review/change of this document was carried out as follows:

Version	Date	Author	Amendments / Change
Issue 1	December 2024	T. Sanderson	Issue 1

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1. INTRODUCTION

1.1. Report Context

Nuclear Restoration Services (NRS) has prepared this Environmental Setting and Site Description Report for inclusion in a Deposit for Recovery bespoke environmental permit application for the recovery of waste at NRS Winfrith, 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) operation to include the use of concrete blocks and demolition arisings (concrete and bricks) from demolition of the 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.

A Waste Recovery Plan was submitted to the Environment Agency in November 2019 for EA opinion with a subsequent version issued in October 2020 following EA input, and a final version issued in March 2021. It has been agreed that these works constitute a recovery activity (Ref. 38).

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).

The purpose of backfilling the voids is to provide a surface level suitable for capping and thereby providing heathland with public access, which is congruent with ES.

The DfR activity permit is being sought to permission with recovery of non-radioactive demolition arisings for the purpose of backfilling voids. 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

The respective division in volumes between DfR and GRR is not defined, with precise volumes of emplacement under each permissioning route to be clarified through detailed design work, further characterisation and emplacement activities.

NRS Winfrith is seeking a bespoke DfR Environmental Permit due to the complexity of proposed operations and local conditions. An overview of the Environment Agency guidance on complying with the Standard Rules for Environmental Permit No.39 (Deposit for Recovery) (Ref. 1), is summarised below, for comparison purposes:

- Parameter 1 — Permitted activities - The storage and recovery of waste. The operator is authorised to carry out the activities presented in Table 2.1 (Ref. 1). These are activities: R5, R10 and R13.
- Parameter 2 — Permitted wastes – Inert wastes and specified non-hazardous wastes as listed in the table of wastes.
- Parameter 3 — Maximum quantity of waste shall be limited to 60,000 cubic metres or less.

- Parameter 4 — The activities shall not be carried out within 500 m of a European Site or a Site of Special Scientific Interest (SSSI); or 50 m of a National Nature Reserve (NNR), Local Nature Reserve (LNR), Local Wildlife Site (LWS), Ancient Woodland or Scheduled Ancient Monument.
- Parameter 5 — The activities must not be carried out within a groundwater Source Protection Zone 1 or 2.
- Parameter 6 — No point source discharges to controlled waters or groundwater.
- Parameter 7 — The activities must not be carried out within 10 metres of any watercourse.
- Parameter 8 — No waste may be deposited into a water body or sub-water table.
- Parameter 9 — The activities shall not be carried out on historic, closed or operational landfills.
- Parameter 10 — Activities must not be carried out in an air quality management area for PM10.

NRS Winfrith will seek a bespoke Environmental Permit, due to the following parameters:

- Parameter 4 - The proposed operations are in proximity to designated habitats. The Site Description Report (Ref. 2) presents a detailed assessment of the land and habitat designations surrounding the Winfrith Site. The majority of the Site is located within the 285 hectare Winfrith Heath SSSI, however, the land immediately surrounding the Dragon and SGHWR reactors, and thus the DfR locations, are excluded from SSSI designation status. Whilst these two locations do not have SSSI status, they are located within 500 m of a SSSI Site, and as such, Parameter 4 of the Standard Rules is not achieved.
- Parameter 8 – The material to be used in the DfR operation will not be in direct contact with groundwater, although some of the concrete structures to be filled are in contact with groundwater. The Hydrogeological Risk Assessment (Ref. 3) illustrates that some below ground in-situ structures of SGHWR are permanently below the water table. The in-situ structures are not a direct discharge and will be suitably engineered to prevent a direct discharge to groundwater from the wastes deposited. No parts of the Dragon facility are below groundwater. The recovery activity will be into the in-situ structures, but not directly in contact with groundwater in current conditions, or reasonable climate scenarios.

1.2. Proposed Activity

The Winfrith nuclear site, located in Dorset, 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 Nuclear Decommissioning Authority (NDA) and operated by Nuclear Restoration Services Limited (NRS), is currently being decommissioned.

The Winfrith Site is a former nuclear research facility undergoing decommissioning to remove hazards on the site and to complete the objective of reaching the defined end state. The Winfrith next planned land use is heathland with public access. The site currently operates within the Nuclear Site Licence and Environmental Permit for RSR activities. The proposed end state for the site includes on-site disposals of the sub-surface SGHWR and Dragon reactor structures, with voids being filled by demolition arisings. The deposits will be capped and landscaped.

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 along with the rest of the Site to deliver the site end state and next planned land use of heathland with public access.

1.3. Supporting Documentation

The DfR permit application and the application to vary the Winfrith radioactive substances regulation permit have similar information requirements. To prevent inconsistencies from the duplication of documents between the GRR and DfR permit applications, this document will serve to signpost to the relevant sections of the reports where applicable.

Any information that has been previously prepared for the DfR or GRR permit applications and would ordinarily be found within an Environmental Setting and Site Description (ESSD) Report, will be signposted to within this document. If the information has not previously been prepared, then the relevant arguments will be made within this report.

1.4. Planning Permission

As has been documented throughout the pre-application engagement with the EA, the Winfrith Site does not have planning permission for the proposed activity at the time of Permit application. A planning application is being submitted to Dorset Council for the proposed activities, combined with the decommissioning, demolition and restoration of the Winfrith Site, alongside this application.

2. SITE DETAILS

2.1. Site Location and Access

The Winfrith site is located in close proximity to the south coast of Dorset, two miles west of the town of Wool and ten miles east of Dorchester. The approximate centre of the site is located at Easting 381328, Northing 086878. The site is relatively low-lying with a topographical gradient from a highpoint in south-west of approximately 50 m Above Ordnance Datum (AOD), to a low point in the north-east of approximately 20 mAOD (Ref. 2).

Access to the Site is via Gatemore Road. To maintain site safety and security during the operations at the Site, access will remain through the barrier-controlled access at the Security Lodge. Further details of the Site Location and Access are presented in the Site Description Report (Ref. 2).

2.2. Site Classification

2.2.1. Geology

The geology of the Site is presented in the Hydrogeological Interpretation report (Ref. 4) and summarised through the Conceptual Site Model (Ref. 5).

Local to the site, the underlying geology is described as consisting of quaternary deposits consisting of head, river terrace and alluvial deposits, Poole formation, London Clay and the Portsdown Chalk Formations. These deposits are described in detail in the Hydrogeological Interpretation Report (Ref. 4). This has been summarised in Table 1.

Table 1: Superficial and Bedrock Geology in the vicinity of the Winfrith Site (Ref. 4)

Geological Group	Formation	Description	Approximate Thickness
Quaternary Deposits	Head	Poorly stratified clay, silt, sand, gravel and Chalk	Up to 4 m thick. Locally absent.
	River Terrace Deposits	Mainly angular flint gravel in a sandy, locally clayey, matrix	
	Alluvium	Soft, organic mud	
Bracklesham Group (Palaeogene)	Poole Formation	Sand and clay	8 m or thicker to the south of the Site, and ~30 m to the north-east
Thames Group (Palaeogene)	London Clay Formation comprising the West Park Farm Member	Sandy clay and sand, locally pebbly	10 m or thicker to the south of the Site, thickness not proven to the north-east [AEA 1994c]
White Chalk (Cretaceous)	Portsdown Chalk Formation	Chalk, soft, marly near base, flintier in upper part	up to 130 m thick regionally

2.2.2. Hydrogeology

The regional and local hydrogeology to the Winfrith Site is presented in detail through the Hydrogeological Interpretation report (Ref. 4).

Head deposits at the site are classified as a Secondary (undifferentiated) aquifer, which is a classification that is given in cases where neither Secondary A nor Secondary B classifications could be assigned to the unit.

Alluvium, River Terrace Deposits and the Poole Formation are classified by the Environment Agency as Secondary A aquifers (Ref. 6), which typically comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and which, in some cases, form an important source of base flow to rivers.

The London Clay Formation is classified as an Unproductive Aquifer which has little or no resource potential.

The Portsdown Chalk beneath the London Clay is a Principal Aquifer.

2.2.3. Groundwater Vulnerability

The Poole Formation is categorised as having medium to high groundwater vulnerability (Ref. 6). Areas of high groundwater vulnerability have the potential to easily transmit pollution to groundwater and are characterised by high-leaching soils and the absence of low-permeability superficial deposits. Areas with medium vulnerability have overlying soils and superficial deposits that offer some groundwater protection.

There are no Source Protection Zones 1 or 2 for public water supplies within a 1 km radius of the Winfrith Site. The closest surround the village of Winfrith Newburgh to the south, where the closest extent of the outer protection zone (Zone 2) is approximately 1.7 km south-east of the site boundary (Ref. 6).

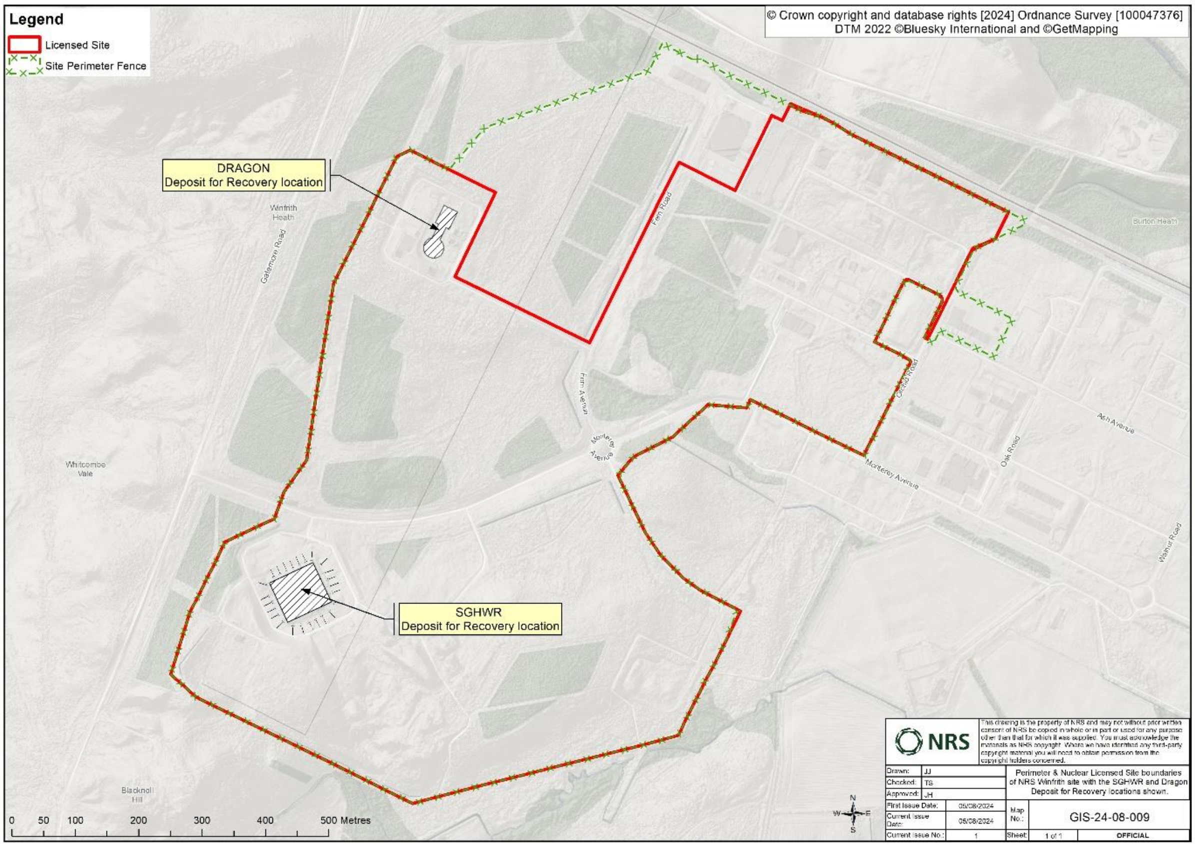
2.2.4. Surface Water Features

Local surface water features and hydrology are presented in the Hydrogeological Interpretation Report (Ref. 4). The report highlights that the site is split on a catchment divide, with the northern catchment (0.75 km^2) being drained to the north-east and east towards Flume 1 and the Frome Ditch surface water features. The southern portion of site (0.12 km^2) is drained towards the south and south-west towards the River Win (AECOM, 2000 in Ref. 4).

2.3. Site Boundary and Security

The Site Description Report (Ref. 2) presents details of the site boundary and security. The current Site perimeter boundary encompasses an area of 87 ha. Within this, a smaller parcel of land of 71 ha demarks the nuclear licensed site. The Site boundary is presented in Figure 1. The perimeter fence will be removed prior to the site achieving its Interim End Point (IEP), once all physical works at the site being complete. Whilst no date has been outlined for the fence removal, it is foreseen that the fence removal will be one of the last activities in the program to achieve the IEP.

Figure 1 - Winfrith Site boundaries, with the Site boundary in green, and the nuclear licenced site boundary in red.



Entry onto the site is permitted to NRS employees, visitors and contractors who hold an authorised site pass. Access to the security-fenced site is via the main gate is controlled by security guard and operates 24-hours per day.

Passes are to be visible at all times whilst within the security-fenced site, except where this is precluded by safety or operational factors. On entry and exit from the site, security conduct checks to ensure compliance. Anyone failing to produce a properly authorised pass may be asked to leave the site.

A site pass will only be issued to persons who have appropriate security clearance and have attended the site induction training. Adhering to the site rules is a key requirement for being provided a site pass. Visitor passes are only be issued if sponsored by an authorised employee who holds a full site pass and is resident on the NRS Winfrith site.

2.4. Former Activity Boundaries

Prior to the site being developed as a nuclear power research and development facility, the site was largely occupied by heathland and agricultural land (Ref. 2). An Envirocheck report (Ref. 7) was requested in 2014 which shows that no active or historic landfill or conventional waste management facilities are located on the Site, or within a 1000 m radius of the Site.

The NRS currently holds an environmental permit (EPR/PB3898DC) for the Winfrith Site. Details of compliance with the current permit are presented in Appendix B.

2.5. Site adaptations under the influence of climate change

NRS have assessed the resilience of the proposed deposits to changes in groundwater elevations under the influence of climate change. Assessing the resilience of the structures enables appropriate precautions to be incorporated within the functional requirements of the engineered caps and within the boundary structures of the underground structures. The current regulatory requirements under the nuclear site licence and RSR environmental permit require NRS to address climate change resilience in new activities (Ref. 37). Furthermore, addressing the influence of climate change on the Site and the resilience of the deposits to climate change will help to demonstrate the suitability of the deposits in the foreseeable future through compliance with the groundwater directives prohibition of direct discharges.

As the basement structures to be backfilled are already in place, they do not fall within the ONR guidance (Ref. 37). However the potential for climate change to impact on groundwater, and therefore the deposited waste, has been assessed.

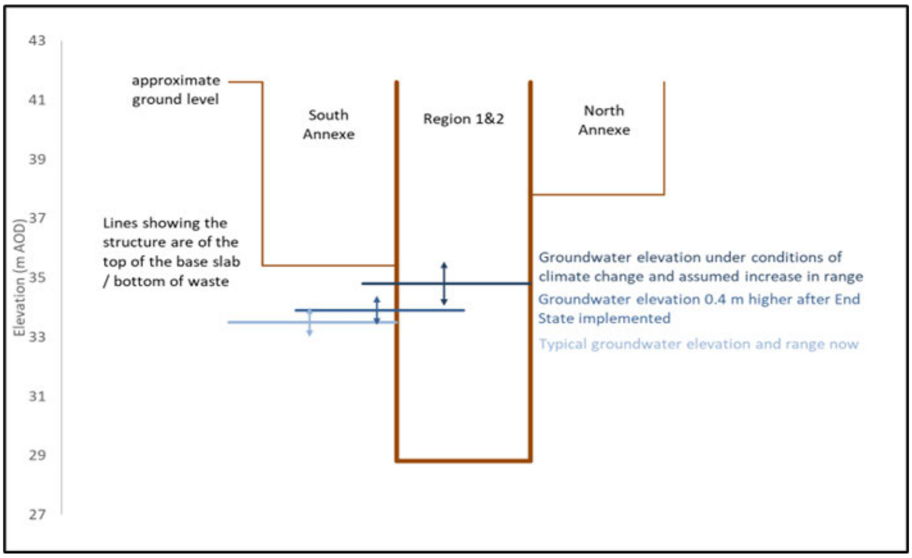
Understanding groundwater behaviour through current and future climate scenarios has been a key consideration in the development of the reactor end state concept designs. The concept designs have had to consider current and future groundwater levels and the potential behaviour of contamination during these scenarios as modelled in the HRA (Ref. 3). Figure 2 shows groundwater levels potentially increasing from present day conditions (actual data), and as anticipated after changes to the site's drainage system at the IEP (as modelled) and during one of a number of future climate change scenarios. The projections shown relate to scenarios where groundwater levels increase (based on modelling), however there is an equal likelihood of groundwater levels decreasing in the modelling. The HRA has considered a cautious central estimate for modelled increases in groundwater levels, a variant case (reasonable worst case) in which groundwater levels are higher due to future climate change, seasonal variations, and an extreme what-if scenario where groundwater annually inundates the South Annexe (Ref. 8).

The Design Substantiation Report (Ref. 13) sets out the requirements for engineering the basement structures to demonstrate they will be resilient to impacts from the reasonable climate change scenarios.

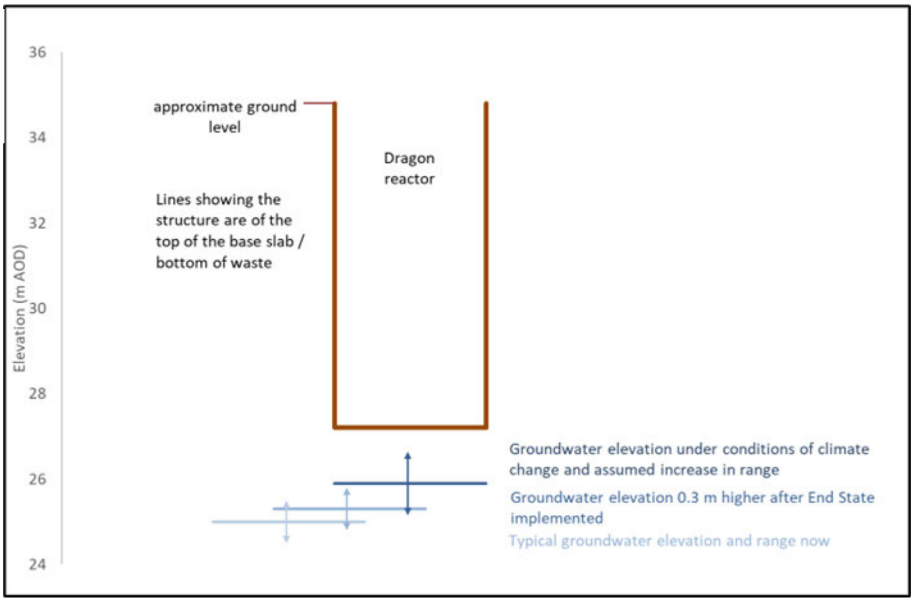
The DSR also provides details on how the engineered caps will be designed and constructed in line with joint ONR / EA guidance on climate change resilience (Ref. 37).

Figure 2 - Average Groundwater elevations (mAOD) at the SGHWR and Dragon disposals

SGHWR Disposal/ Deposit



Dragon Disposal/ Deposit



Through the use of simple engineering tools and following the functional requirements presented in the Design Substantiation Report (Ref. 13), the structure will prevent any direct discharges to groundwater. Any penetrations or cracks identified in the boundary structure (those external walls of the underground structures which are currently or will be under the reasonable worst case groundwater levels) will undergo Construction Quality Assurance (CQA) assured engineering to ensure that a leak path does not exist and therefore no direct discharges to groundwater will develop.

2.6. Operator Competency

2.6.1. Competency Required

Environmental Permitting Regulations 2016 Standard Rules SR2015 No.39 (Ref. 1) states that the operator must comply with the requirements of an approved competence scheme. The competency schemes available for a DfR operation are the CIWM WAMITAB scheme (Ref. 9) or the Energy and Utility Competence Management System (Ref. 10).

Consultation with the CIWM risk matrix (Ref. 9) indicates that the risk profile of the operations are not based on the scale of the planned operations. The risk is based on the nature of wastes to be emplaced and if any treatment operations are proposed. As there are no mobile treatment plant operations (crushing) being undertaken or planned at the site, then there are two certification options:

- Level 4 Medium Risk Operator Competence for Non-hazardous waste treatment and transfer (601/8528/4) (MROC1); and
- Level 4 Certificate in Waste and Resource Management (603/3581/6) (VRQ410).

The WAMITAB competencies stated above are suitable for the site operations, including any sort and segregate operations of stockpiled rubble to meet the requirements of the Emplacement Acceptance Criteria (EAC). The EAC presents the waste acceptance criteria for the site. Since some augmentation of the basement structures of SGHWR and Dragon will be required, including the sealing of penetrations, the EAC also ensures the compliance of materials used through these operations. Consequently, the EAC presents compliance criterium for all materials to be emplaced within the deposits, whether waste or for engineering purposes.

2.6.2. Competency Management System

Competencies within NRS are managed through Standard S-035 in accordance with the requirements of the Nuclear Site Licence and the current Environmental Permit for Radioactive Substances Regulation (EPR/PB3898DC). Standard S-035 (Ref. 11) presents all work streams at NRS which require any pre-requisite training or competency, most notably where there are regulatory requirements associated.

S-035 sets the training, qualification and experience requirements to ensure that the company and individuals are Suitably Qualified and Experienced Personnel (SQEP) to undertake activities and tasks. S-035 also identifies where routine refresher or renewal of training is required.

Any competencies that are listed in S-035 are identified through a unique Authorisation Instruction (AI) number. The Authorisation Instruction includes the mandatory training and experience requirements that need to be met to allow an employee to undertake or authorise an operation. S-035 also provides details of how often training needs to be renewed.

Employees whose roles identify them as operators of the DfR scheme in NRS can apply for CIWM accredited WAMITAB training through the NRS training portal. Following training, employees will be notified of upcoming revalidations through automatic notifications.

The WAMITAB training scheme is not yet set up in NRS' training portfolio, however the training and the management through standard S-035 will be in place prior to it being required.

2.6.3. Application of WAMITAB

Under the CIWM/WAMITAB guidance, the Technically Competent Manager of the operation has 4 weeks from permitting activities commencing to obtain the necessary competency qualification. The guidance additionally states that evidence of the registration for the qualification is to be provided within the application.

Applications for DfR activities are being submitted well in advance of intended implementation. This is partly to allow sufficient time for determination, but also to allow development of the detailed design. Therefore, it is not possible to specify the competent individuals at the time of application as any training would be out of date prior to implementation and resources may change in the interim. For permit compliance, NRS displays the permit at the main entrance in all buildings. Furthermore, an additional responsible Permit holder is identified for each facility. This management arrangement will continue to be adopted under the WAMITAB arrangements.

NRS requests a pre-commencement condition to provide the names and proof of competency of Technically Competent Managers be the Environment Agency prior to the commencement of work.

3. COMPLIANCE POINTS

3.1. Groundwater Compliance Points

Groundwater compliance points are described in detail in the Hydrogeological Risk Assessment (Ref. 3). Groundwater compliance points for hazardous and non-hazardous substances are presented below:

- Hazardous substances: The compliance point for hazardous substances is groundwater in the Poole Formation immediately downgradient of the deposits. This is where a theoretical abstraction well is located in the Conceptual Site Model (Ref. 5); and,
- Non-Hazardous pollutants: The compliance point for non-hazardous pollutants is in groundwater of the Poole Formation between the deposits and the closest groundwater receptor. The closest groundwater receptors are surface waters, or the root-zone of terrestrial groundwater fed ecological systems. The compliance point for modelling has been set to 50 m downgradient of the deposits.

3.2. Surface Water Compliance Points

Surface water compliance points are presented in the HRA (Ref. 3). The closest surface water compliance point is the River Frome, which is located 900 m downgradient of the Dragon reactor. The River Frome at this location is the surface water receptor.

4. POLLUTION CONTROL MEASURES

4.1. Security Infrastructure

The site perimeter fence and security arrangements, in accordance with the Nuclear Site Licence and current RSR Permit, will be maintained through the remainder of the decommissioning and restoration activities. Security is delivered through the Site Security Plan (SPP). This will ensure the security for the proposed DfR activities. The perimeter fence will only be removed once all decommissioning, waste management and restoration activities are complete, when the site achieves its IEP.

Security controls are in compliance with the nuclear site licence and environmental permit requirements for security and are presented in the Winfrith Site Rules and Regulations (Ref. 25) and summarised in the Site Description Report (Ref. 2).

Until the IEP the site security will be controlled by an on-site security team, with routine patrols and checks of the perimeter fence line. The patrols of the fence line will be managed in-line with the fence removal at an as-yet unspecified date prior to the IEP.

After the IEP, the site will be publicly accessible. Groundwater monitoring will continue after the IEP and wells will be protected against possible contamination through secure locked headworks where borehole headworks are above ground. Where flush borehole covers are in-place, these will be bolted closed.

4.2. Groundwater Control

There are no groundwater control systems or measures in place currently at the Site, nor any planned for the future.

4.3. Surface Water Management

There are no surface water management systems in operation at the deposits. A peripheral ditch is to circumference the base of the cap at each of the deposits (Appendix A) to intersect any potential runoff from the cap.

The peripheral ditch will discharge into a soakaway.

4.4. Pollution Control Infrastructure

There is no pollution control infrastructure to be installed at the Site as the primary aim is to decommission the site and restore it in accordance with the end state of heathland with public access. The Restoration Management Plan (Ref. 36) illustrates that all infrastructure other than that required for public access, security and site access be removed and decommissioned.

5. ENGINEERING OF THE DEPOSITS

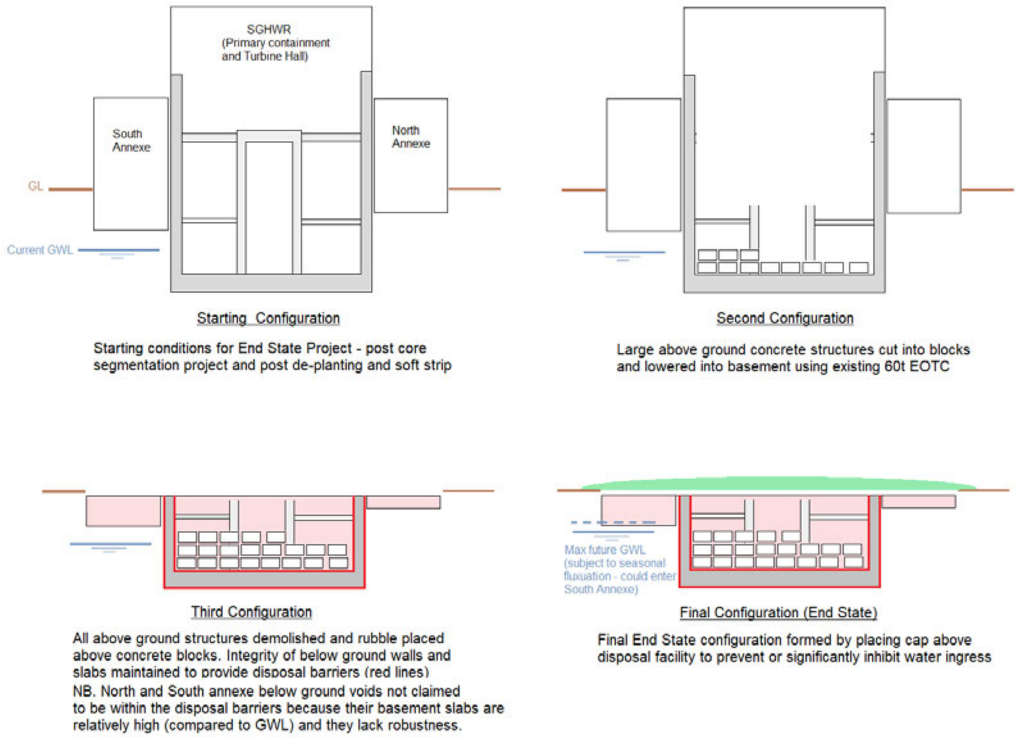
The below ground structures of the Dragon and SGHWR facilities which are set to become the basal and sidewall engineering of the deposits were constructed in the 1960’s and were built in accordance with the engineering standards of the time to support nuclear operations. They were not built for purpose engineered disposal / deposit facilities. NRS has developed a robust set of functional requirements to ensure that modifications are implemented on the structures, and backfill is managed in such a way, to create a fit-for-use deposit. The functional requirements are laid out in the Design Substantiation Report (Ref. 13).

The deposits are to be backfilled under two permitting regimes, the DfR and the GRR. The DfR permit seeks to use non-radioactively contaminated demolition arisings from the above ground structures of SGHWR and Dragon, and demolition arisings stored in the D630 stockpiles. Details of the backfill are presented in the Design Substantiation Report (Ref. 13) and the Construction Quality Assurance Plan (Ref. 14).

The GRR permit seeks to use radioactively contaminated demolition arisings and large concrete blocks cut from the structure of the reactors to emplace within the disposal.

A schematic of the proposed backfill design for SGHWR is presented in Figure 3.

Figure 3 - Schematic representation of SGHWR demolition and filling sequence



5.1. Basal and Side Slope Engineering

The concept design in the DSR (Ref. 13) has shown that compliant deposits can be delivered using the basement structures of SGHWR and Dragon. Compliant deposits can be achieved with some augmentation of the structures to ensure structural stability and to maintain the external boundary during demolition.

The basal and side slopes of the deposits are formed from the in-situ below ground structures. The in-situ structures were built for the purpose of housing nuclear reactors and associated equipment and are therefore robust structures. Additional structural integrity assessment has been completed to demonstrate the structures are suitably engineered containment. There will be no formal engineering as this is not a built for purpose facility.

The Design Substantiation Report (Ref. 13) presents the permeability and hydraulic conductivity of the structures, however notes that due to concerns over robustness of structures of the North and South Annexes it is not possible to make any claims over the permeability of these structures and the HRA does not make any claims on these structures. Nonetheless, protecting the integrity of the structures will be of paramount importance through the demolition sequencing and delivery.

Environment Agency guidance on earthworks for landfill engineering (Ref. 12) stipulates a maximum hydraulic conductivity equivalent to 1 m thickness at a maximum permeability $1x10^{-9}$ m/s. Whilst the engineering of the SGHWR and Dragon facilities does not directly match the guidance , this section will serve to explain the suitability of the structures engineering as a substitution.

5.2. Engineering of the SGHWR Reactor

Constructed in the early 1960’s, the SGHWR consists of a large robust concrete structure below ground level, with steelwork and cladding forming the above ground structure. At the heart of the structure is the primary containment (PC) which formally housed the operating reactor core, steam drums and fuel storage pond. To the north and south of the reactor building are shallower adjoining annexe structures that consist of a complex system of rooms. Figure 4 shows a plan view of SGHWR, and Figure 5 shows a cross section through the PC and North and South Annexe structures.

Figure 4 - Plan view of SGHWR

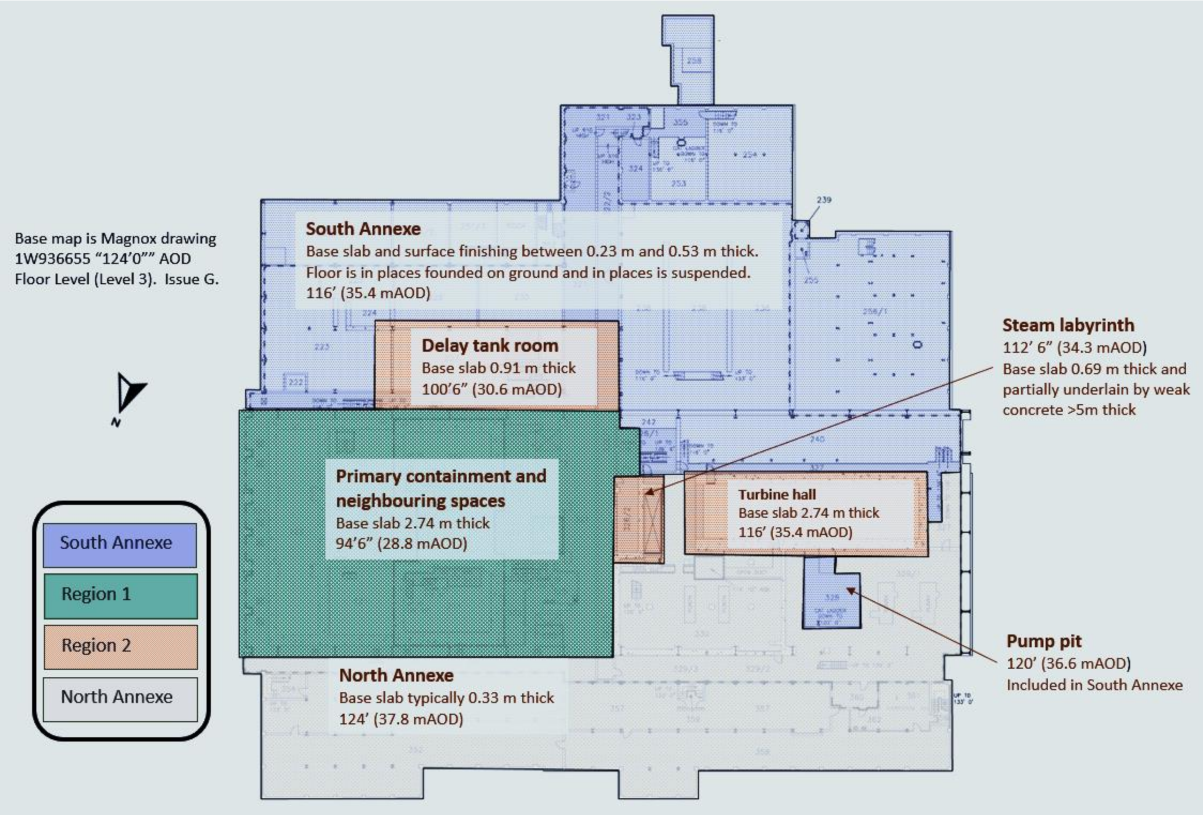
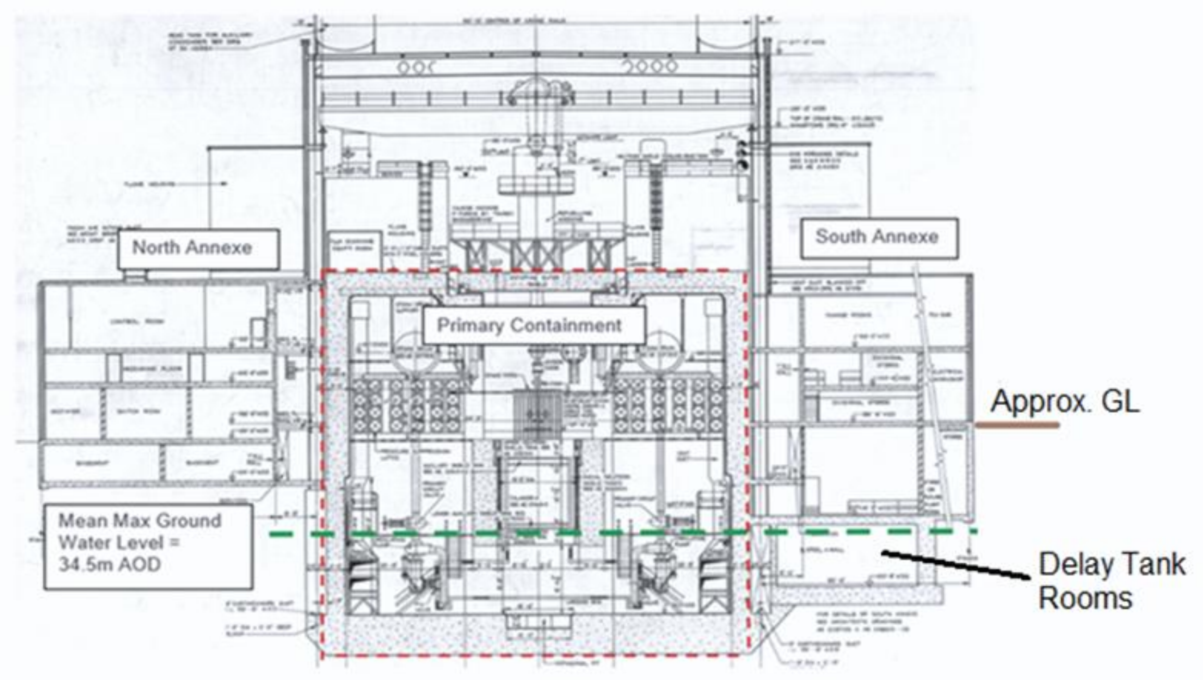


Figure 5 - North-South section through SGHWR showing the PC and annexe structures relative to groundwater level



The PC was designed and built to prevent groundwater ingress, contain pond water and to remain as 'leak-tight' as possible. The structure is made up of 1.2m thick reinforced concrete walls and a 3m thick reinforced concrete raft foundation. No construction specification is available, so no technical definition of 'leak tight' or 'watertight' has been found. However, it is clear that the parts of SGHWR which are exposed to groundwater were specifically designed to resist water egress and ingress as far as was reasonably practicable with PVC water bars included within the structure. A waterproofing admixture, Prolapin, was added to the concrete to reduce the permeability of concrete. It has been concluded reasonable to assume that the likely current permeability of the SGHWR Primary Containment concrete is in the range of $1x10^{-10}$ and $1x10^{-12}$ m/s.

The proposed demolition plans for the SGHWR are to remove all structures to a level consistent with 1 m below ground level (m bgl). As such the top sidewall engineering of the deposits (provided by the concrete structure of the SGHWR facility) will terminate at 1 m bgl. Backfill from demolition arisings will be placed to the top of the structure at 1m bgl.

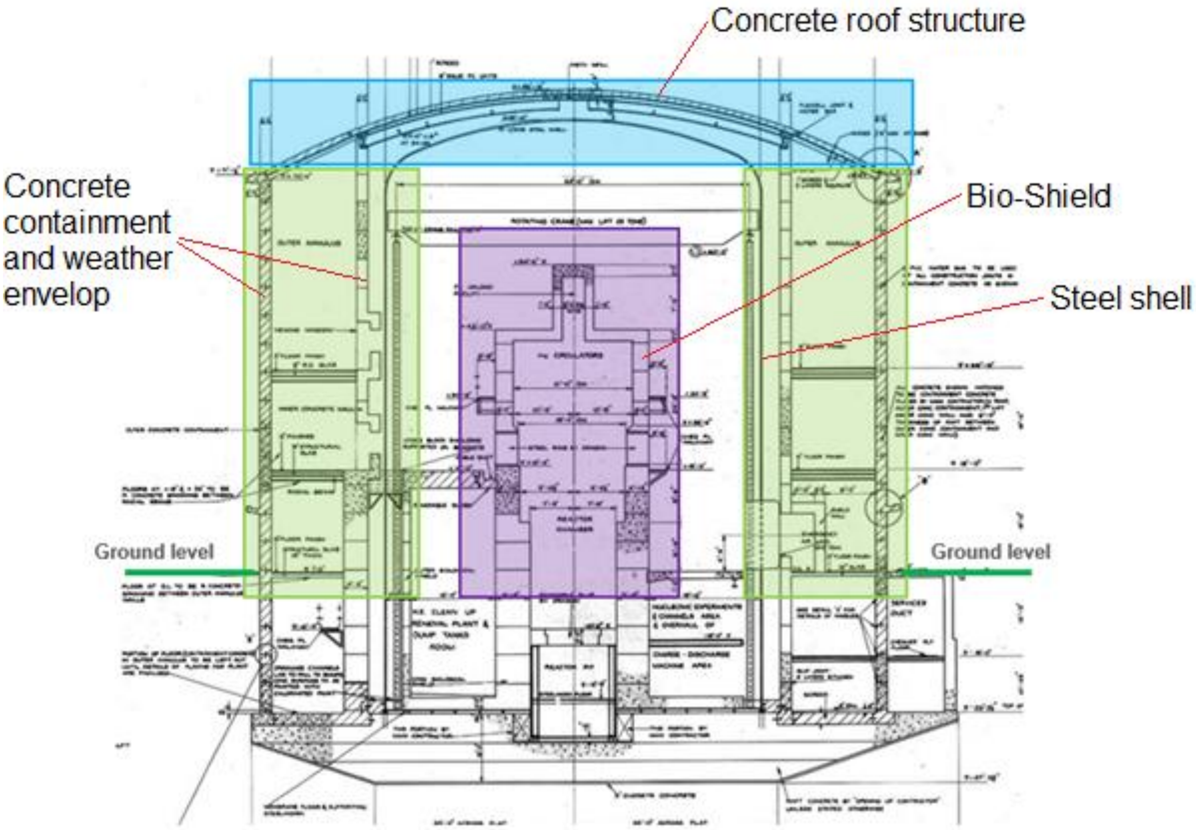
Whilst the sidewall engineering for SGHWR may not extend all the way to ground level due to the cut line at 1 m bgl, the uppermost 1 m will be protected by a cap and suitable cover. The cap design drawings in Appendix A illustrate the keying together and tie in details of the cap and sidewall engineering.

5.3. Engineering of the Dragon Reactor

The Dragon reactor was constructed between 1960 and 1965 and the structure is comprised of three concentric rings. The reactor is cylindrical in shape, 26 m high and 35.5 m in diameter with a basement extending to 7.6 m below ground level, with a 3.7 m steel-reinforced concrete base slab beneath. The structure includes an inner concrete bioshield, a metal internal structure and a concrete shell and roof. Figure 6 shows a general section through the structure.

The Dragon reactor structure sits above the current groundwater level and most modelled climate change scenarios. Additionally, as the Dragon reactor was helium cooled, it did not include any water based systems, as the SGHWR did. Therefore there was no requirement to eliminate water ingress and egress at Dragon and there is no evidence for the use of waterproofing admixtures or the use of Prolapin as occurred at SGHWR.

Figure 6 - Section through the Dragon Reactor



Since the topography surrounding the Dragon reactor is more variable than that of SGHWR and the structure sat in a depression, the proposed demolition cut-line for the reactor is at ground level. Backfill from demolition arisings will be placed up to ground level. The sidewall engineering of the deposit will extend from the base of the deposit to ground level (Ref. 14). The cap design drawings in Appendix A illustrate the keying together and tie in details of the cap and sidewall engineering.

5.4. Groundwater interactions with basal engineering

The HRA (Ref. 3) illustrates that some below ground in-situ structures of SGHWR are permanently below the water table in the Poole Formation. Whilst the below ground structure of SGHWR is in contact with groundwater, the deeper structures are robust and will be sufficiently assessed and engineered to ensure the material to be used in the DfR operation will not be in direct contact with groundwater. The in-situ concrete structures are not a direct discharge and will be suitably engineered to ensure waste contained will not be a direct discharge to groundwater at current or in reasonable climate change scenarios.

No parts of the Dragon facility are below groundwater either currently or in climate change scenarios. The recovery activity will be into the in-situ structures.

The base of the Dragon reactor is above groundwater levels at current, however in certain climate scenarios, the groundwater will exceed the level of the slab for 4% of the time (Ref. 7), however would not reach the level where waste is to be deposited. Additionally, the Dragon structures are robust and show no signs of deterioration.

In order to satisfy compliance with groundwater regulations, a series of functional requirements (Ref. 13) have been established to ensure compliance with regulatory requirements. Implementation of the Functional Requirements will be monitored through the CQAP.

5.5. Engineering Functional Requirements

The Design Substantiation Report (Ref. 13) highlights the functional requirements of the basement structures, deposits and caps. Eleven functional requirements have been developed for the deposits, however, specifically applying to the reactors (and therefore the sidewall and basal engineering of the deposits) are requirements: FR2, FR3, FR4 and FR5. These are presented in Table 2.

Table 2 - Key Functional Requirements from the Design Substantiation Report relating to the basal and sidewall engineering (Ref. 13)

<table>
<tr><th>FR</th><th colspan="2">Description</th></tr>
<tr><td>FR2</td><td colspan="2">Minimise the demolition of the below ground structures at SGHWR and Dragon in order to reduce the production of waste that might require management off-site and reduce the amount of work and the resultant increased risk to worker health and safety and protection of the environment.</td></tr>
<tr><td rowspan="3">FR3</td><td colspan="2">Throughout all stages of the demolition and construction of the disposal facilities, maintain the structural integrity of ground bearing slabs and external walls which will form the disposal boundary walls such that direct discharges are avoided by:</td></tr>
<tr><td>FR3.1</td><td>Avoid construction activities that may damage boundary walls, noting the relative performance of boundary walls is defined in the structural integrity assessment.</td></tr>
<tr><td>FR3.2</td><td>Ensure that demolition is controlled to avoid detrimental point loading of walls and slabs and also to restrict impact loading from falling demolition arisings to acceptable levels.</td></tr>
<tr><td>FR4</td><td colspan="2">Make reasonable endeavours to identify existing penetrations and structural weaknesses in the disposal boundary structures which could allow direct discharges into groundwater under reasonable worst case conditions (i.e. non-atypical groundwater levels). Where necessary propose measures to close these leak pathways.</td></tr>
<tr><td>FR5</td><td colspan="2">Consider the condition of the structure and identify any degradation mechanisms, current or future, that could give rise to direct discharges. Propose design measures to address these mechanisms, where deemed appropriate.</td></tr>
</table>

The functional requirements presented in Table 2 highlight the measures undertaken through the conceptual design stage and will be carried through the detailed design phase to ensure compliance and demonstrate remedial actions that will be taken to ensure compliance with all regulatory requirements. The functional requirements will demonstrate that the activities will mitigate groundwater ingress and leachate leakage from the deposits.

The DSR (Ref. 13) summarises how the Environment Agency’s expectations are to be met through implementation of the deposit.

The DSR (Ref. 13) highlights the need to maintain the integrity of boundary structures. Boundary structures are the below ground structures that form the external boundary between the deposit and the groundwater saturation zone (under both current and future climate change scenarios). The DSR (Ref. 13) sets out the engineering and backfill requirements to prevent direct discharges of groundwater. These requirements will be developed further through the delivery of the detailed design through application of a Construction Quality Assurance Plan (Ref. 27).

The current design, as set out in the DSR, detailed the requirements to meet regulatory requirements, however, the process for how this will be undertaken will be confirmed through the detailed design phase. The application CQAP (Ref. 14) highlights potential phases of this work including remedial works and condition surveys to assure the integrity of the structure.

5.6. Cap Engineering

The deposits are to be capped with an engineered capping system used conventionally across the landfill industry. A concept design of the caps has been developed, and will be optimised during the detailed design stage. Conceptual designs of the caps for the SGHWR and Dragon deposits are presented in Appendix A.

The purpose of the capping over the deposit is to restrict infiltration of rainwater and promote surface water runoff to reduce the volume of water that permeates into the disposal. Reducing the volume of infiltrating water will protect the waste condition by reducing the potential for contaminant release through leaching. The cap designs additionally will serve to protect the waste from damage through wind and rain-borne erosion, and intrusion from plants, animals and humans.

The concept cap designs are highly engineered composite caps with protection layers and geomembranes, the designs are illustrated in Appendix A.

All cap engineering works are to be completed and signed-off under CQA assurance and quality control. The cap designs are designed to achieve a maximum hydraulic conductivity of 10^{-9} m/s.

The caps are designed to be sufficiently flexible through the use of flexible membrane layers to permit some settlement without damaging the capping system thus increasing potential infiltration.

The original scoping of the cap engineering was prepared by Atkins (Ref. 28) with a Technical Memorandum (Ref. 22). Details of the current deposit caps (pending optimisation) are presented in Table 3. These are presented from surface to deeper depths.

Table 3 - Proposed Deposit Cap Structure and Thicknesses – pending optimisation

Material	SGHWR and Dragon	Details
Topsoil	400 mm	This is a layer of at least 0.40 m of subsoil and 0.40 m of topsoil to act as a substrate for vegetation.
Subsoil	400 mm	
Geotextile	Nominal	A dense geotextile is placed above the anti-intrusion barrier to minimise particle migration into the underlying anti-intrusion and drainage layers. This geotextile would not need to be a low permeability barrier like a FML or GCL.

Material	SGHWR and Dragon	Details
Anti-Intrusion Layer	300 – 600 mm	The function of the anti-intrusion layer is to reduce the risk of damaging the integrity of the low permeability barrier by burrowing animals, penetrating roots and human intervention. The layer provides additional protection from erosion and serves to further discourage intrusion into the wastes. The layer should be constructed of compacted cobbles in the range 0.10-0.15 m with a thickness of 0.3 – 0.6 m to prevent intrusion by large burrowing mammals (e.g. badgers) and make deliberate human intrusion difficult to achieve without specialist digging equipment. Since the layer will be poor in nutrients (relative to the base horizons of landscaping above) and free draining (relative to the drainage layer below), it should deter the intrusion of deeper rooting vegetation (i.e. trees) into the lower horizons and will serve a further purpose of providing additional drainage capacity during storm events.
Drainage Layer	300 – 450 mm	A minimum 0.30-0.45 m thick drainage layer, of noncalcareous gravel (grain size 16-32 mm), to achieve a permeability of no less than 10^{-4} m/s. The function of the drainage layer is to provide subsurface drainage above the low permeability barrier layers within the cap by promoting lateral drainage. The drainage layer must be graded to function without excessive clogging by sediments, chemical precipitation, bio-fouling, or physical clogging. This means the potential for a standing head of water above the low hydraulic conductivity layer is minimised. It also maintains the stability of the cap by reducing and controlling pore water pressures at the interface with the underlying barrier layer. This is important where there is sufficient rainfall to potentially saturate the cover soil.
Geotextile	Nominal	A <5mm thick geotextile sits above the FML to minimise damage to the flexible membrane layer during the placement of overlying materials.
Flexible Membrane Liner	Nominal	A geomembrane of extruded polymer sheet of either low-density polyethylene or a high-density polyethylene with a thickness of <1 mm. Typical hydraulic conductivities of low density and high density polyethylene geomembranes are ~ 10^{-14} m/s, but can be as low as 10^{-15} m/s.
Geosynthetic Clay Liner	Nominal	A composite structure with a high internal shear strength. It is assumed it consists of a ~5mm layer of bentonite embedded between two needle punched layers of geotextile. The hydraulic conductivity for a GCL is typically in the range of 10^{-10} to 10^{-12} m/s.
Clay	500 mm	A clay mineral liner, of at least 0.50 m thickness, formed by reworking/compaction in defined layers of imported clays or mudstone, achieving a maximum air content of 5% to produce a liner with hydraulic conductivity less than 10^{-9} m/s.
Regulating Layer	300 – 600 mm	A regulating layer consisting of coarse gravel (grain size: 16-32mm) between 0.30-0.60 m thick placed directly on top of the geotextile. This layer mitigates surface water breakout by providing a preferential horizontal flow path for water in the event of catastrophic cap failure resulting in full saturation of the below ground voids.
Geotextile	Nominal	A dense geotextile (typically less than 5mm thick) should be laid over the emplaced material prior to capping to provide separation and prevent loss of capping materials during installation.

Following the completion of the optimisation process for the capping designs, the proposed design will be distributed and appended to this report for further reference.

5.7. Settlement of the Deposits

Engineering approaches are to be utilised in the emplacement of waste to prevent as far as possible the settlement of the backfill. Where large above ground concrete walls are to be removed, these will be preferentially cut into large blocks and placed directly into the basement structures. Emplacing large blocks will act to limit backfill settlement and help to maintain the integrity of the cap (Ref. 14). Additionally using large concrete blocks in below ground void backfill will reduce the potential for leaching due to having a lower surface area compared to demolition rubble arisings. Demolition rubble will be placed on top of concrete blocks to fill any remaining void space. There is no intention to undertake crushing operations on the demolition rubble.

Settlement of the deposits through self-compaction of demolition arisings is calculated to be between 10 and 50 mm at Dragon and between 35 and 100 mm at SGHWR. Furthermore, due to the angular nature of the backfill, the majority of the settlement is accounted for during backfill operations (Ref. 35).

The demolition and backfill processes will be undertaken in a manner which will minimise the potential development of voids within the backfill and maximise self-compaction of the demolition arisings. The demolition techniques to be used will ensure materials are <150 mm in size. This will limit potential settlement of both the backfill and the cap, thereby reducing the risk of cap deformation (Ref. 14). Differential settlement is assessed in the Structural Integrity report (Ref. 15). The report demonstrates that for both the SGHWR and Dragon structures, there are no substantial concerns in relation to differential settlement that would require engineering intervention.

The Structural Integrity report (Ref. 15) also assessed the impact of buoyancy of the deposits. Assessment has shown (Ref. 15) that buoyancy will not have an impact on structural integrity since the backfilled structures will have a lower mass than that of the building during its operational phase.

6. POST CLOSURE (AFTERCARE) CONTROLS

6.1. Winfrith End State

Once the deposits have been constructed the site will be restored to heathland with public access in line with the end state for the site. This period is generically referred to as Stewardship and incorporates the aftercare for the deposits, on-going management of the radioactive wastes disposals and restoration and habitat management activities.

6.2. Post Closure Controls

The period of post-closure controls refers to the period of time between the construction of the deposits and the surrender of the permit. Due to the staged nature of works with the construction of the Dragon deposit commencing prior to SGHWR, the post closure controls for Dragon will commence at an earlier time than that of SGHWR. Post closure management arrangements of the site are discussed in the Stewardship Plan (Ref. 16).

Once the deposit has been constructed and capped at SGHWR, and all physical works at the site have been completed, including road and perimeter fence removal, the site will achieve its Interim End Point (IEP).

An application to surrender the DfR permit will occur once the site has demonstrated that the deposits are performing as anticipated. This will be demonstrated through the validation monitoring of the end state performance, and regulatory confidence that any future evolution of the site will not be detrimental to the environment. It is currently assumed that the DfR and the RSR permits will be surrendered at the same time.

6.3. Records management

All site records will be collated into a completion report and shall be retained as part of the site record and documented in the SWESC. The completion report will also include:

- All method statements of all demolition, construction, waste emplacement, capping and monitoring works undertaken at the Site;
- A site diary completed during the programme of works, including: demolition, waste emplacement and capping. The site diary must be prepared during physical works at the Site;
- Documentation of all licenses, consents and permits issued by Statutory and Regulatory Authorities and evidence of compliance of these;
- Documentation of characterisation and sourcing of site derived demolition arisings which have been deposited, quantities of demolition waste emplaced within the deposits alongside any relevant plans and records of waste emplacement.

In addition to the Site Completion Report, a final version of the Hydrogeological Risk Assessment will be produced to aid the development of the final Site Wide Environmental Safety Case (SWESC). The final SWESC will present the case for the deposits performing as anticipated, and within the boundaries of the Hydrogeological Risk Assessment. The final SWESC will form a significant component of the permit surrender case.

Validation monitoring arrangements to assess the performance of the deposits is presented in the Environmental Monitoring Plan (Ref. 21). The EMP aims to demonstrate the deposits are performing as expected and within the bounds of the relevant risk assessments. The monitoring data will be stored and collated in accordance with ‘Management of Records’ in the Stewardship Plan (Ref. 16).

The Stewardship Plan (Ref. 16) highlights the controls that will be in place at the site between the construction of the deposits until the SRS (Ref. 16). Since the construction of the Dragon deposit will be completed prior to the commencement of SGHWR, the Dragon deposit will enter the period of stewardship earlier than that of SGHWR. The Winfrith site will continue to be insured with Public Liability Insurance through to the SRS and successful surrender of both the RSR and the DfR environmental permit.

All records surrounding the descriptions of the waste, waste compliance audits, characterisation and acceptance procedures will be stored and available for permit surrender. In addition, evidence of non-compliant wastes, including characterisation and proof of appropriate discharge routes and waste transfer documents will be stored.

6.4. Proposed Post Closure Management of the site

During preparations for the end state, NRS will return the site to a more natural hydrological function which is in-line with establishing a habitat suitable for heathland development. This will be achieved by removing or blocking the site drainage system and introducing a passive water management system that will both encourage a wet-heathland habitat and protect neighbouring areas from flooding.

6.4.1. <u>Groundwater Management Systems</u>

The next planned land use of the site is heathland with public access. Part of providing sustainable habitats and mitigating potential flood risk will be constructing a mire feature in the north of the site (100m+ from the deposits at SGHWR and Dragon). Given the mire is an ephemerally dry feature that will intercept groundwater at its seasonal high elevation, it will act as a passive groundwater management feature (Ref. 36). The Stewardship Plan (Ref. 16) details the proposed groundwater management systems for the aftercare of the Site.

6.4.2. Surface Water Management Systems

As part of delivering heathland with public access, passive management systems are preferred for the management of surface water (Ref. 16).

The majority of surface water on the site is currently routed via a 48" main to the River Frome via a culvert under the south-west main line railway.

Through decommissioning and restoration activities, the current surface water management system will be decommissioned and a more naturalised hydrograph instated as part of the overall scheme. This will include the construction of a mire feature (Ref. 36). Surface water will continue to be routed via the culvert to the River Frome. Details of the layout of the mire within the site are presented in the Restoration Management Plan (Ref. 36).

6.5. Mining Related Subsidence

The Site is not reported to be affected from mining related subsidence due to being located off the Cheshire Brine Subsidence Compensation District and is not located near any coalfield.

6.4 Completion criteria

The completion criteria required for the eventual surrender of the DfR permit have been taken from the Environment Agencies guidance on '*Landfill and Deposit for Recovery: aftercare and permit surrender'*. In order to successfully surrender the permit, evidence needs to be provided that no active control measures are required to manage the site, emissions from the site are not detrimental to the environment and are below compliance limits and that the settlement of the waste is within the permitted range. A surrender risk assessment must also be completed demonstrating that no significant pollution event has occurred and that the site has been restored to a satisfactory condition.

Under the requirements of the DfR permit, monitoring of the settlement of the cap must be undertaken at a minimum frequency of annually. The cap monitoring requirements are set out in the EMP (Ref). The cap monitoring must consist of a topographic survey which identifies dips and hollows in the cap, and where slopes with a gradient greater than 1:6 are present, these must be monitored more frequently. It should be noted that there are not anticipated or expected to be any slopes on the deposit caps which exceed this slope.

Settlement of the cap, and by virtue the waste is deemed satisfactory if the change in ground level from the topographic survey is not statistically significant when compared to the previous two annual surveys. The Environment Agency define statistically significant as a greater than 5% variance.

Emissions monitoring are required to ensure that emissions from site are acceptable and pollution control systems are working. No gas or surface water monitoring is planned to be undertaken for the deposits, as set out in Section 7.3 and 7.5. Consequently, the emissions monitoring will derive from groundwater only.

No active control measures are foreseen for the Winfrith Site after the IEP.

7. MONITORING

7.1. Monitoring Arrangements

NRS has a robust set of monitoring and management arrangements for the construction and aftercare of the deposits.

The construction of the deposits will be managed by the Construction Environmental Management Plan (CEMP) (Ref. 34) and the existing site-wide environmental monitoring.

The aftercare of the deposits upto the permit surrender will be monitored by the Environmental Monitoring Plan (Ref. 21) and the management of the site through the Stewardship Plan (Ref. 16).

7.2. Weather Monitoring

7.2.1. Rainfall Monitoring

NRS Winfrith operated a rain gauge on site between 1961 and 2004, with a tipping bucket rain gauge operated since August 2022.

The current rain gauge is located at grid reference SY 81487 87403. The gauge auto-logs at 15-minute intervals with data downloaded from the gauge once monthly. Monthly rainfall totals from the gauge between September 2022 and April 2024 presented in Table 4.

Table 4 - Monthly precipitation totals at the Winfrith Site (September 2022 - April 2024)

Month	Precipitation (mm)	Month	Precipitation (mm)
September 2022	66	July 2023	104
October 2022	92	August 2023	60
November 2022	221	September 2023	67
December 2022	139	October 2023	187
January 2023	121	November 2023	150
February 2023	11	December 2023	180
March 2023	114	January 2024	94
April 2023	71	February 2024	184
May 2023	64	March 2024	122
June 2023	27	April 2024	67

A historic rain gauge was operated at the Site between 1961 and 2004 which is used as the baseline for average monthly precipitation. The monthly average precipitation during this period is presented in Table 5.

Table 5 - Average Monthly Precipitation for the Winfrith Site (1961 - 2004)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Monthly Precipitation (mm)	100.0	73.4	73.2	61.3	53.9	52.7	45.3	58.5	77.2	102.2	107.4	110.1

Charts of monthly rainfall precipitation between 1961 and 2004, and average monthly rainfall over this period are presented in FiguresFigure 7 andFigure 8.

Figure 7 - Monthly precipitation at the Winfrith Site (1961 - 2004)

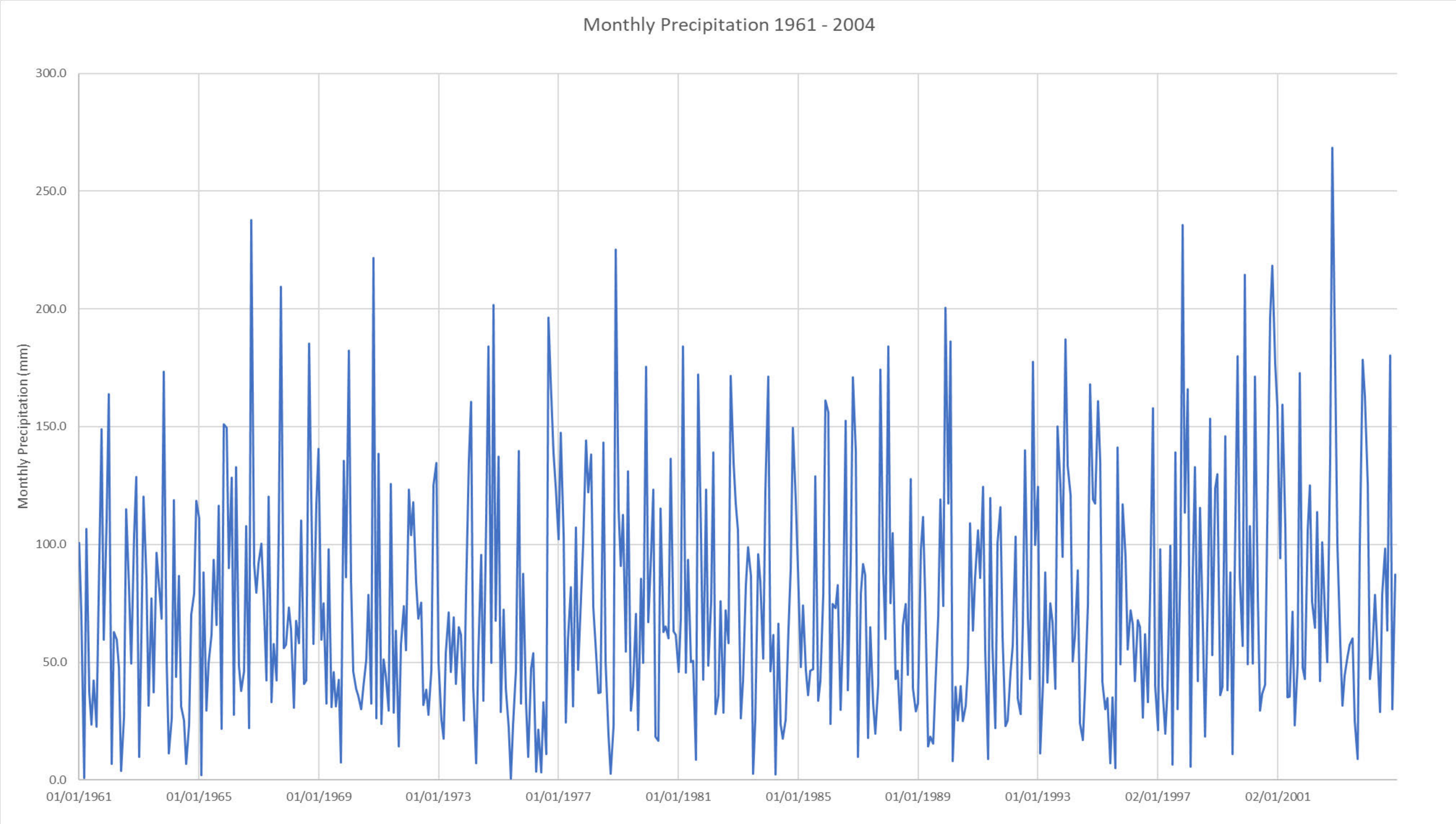
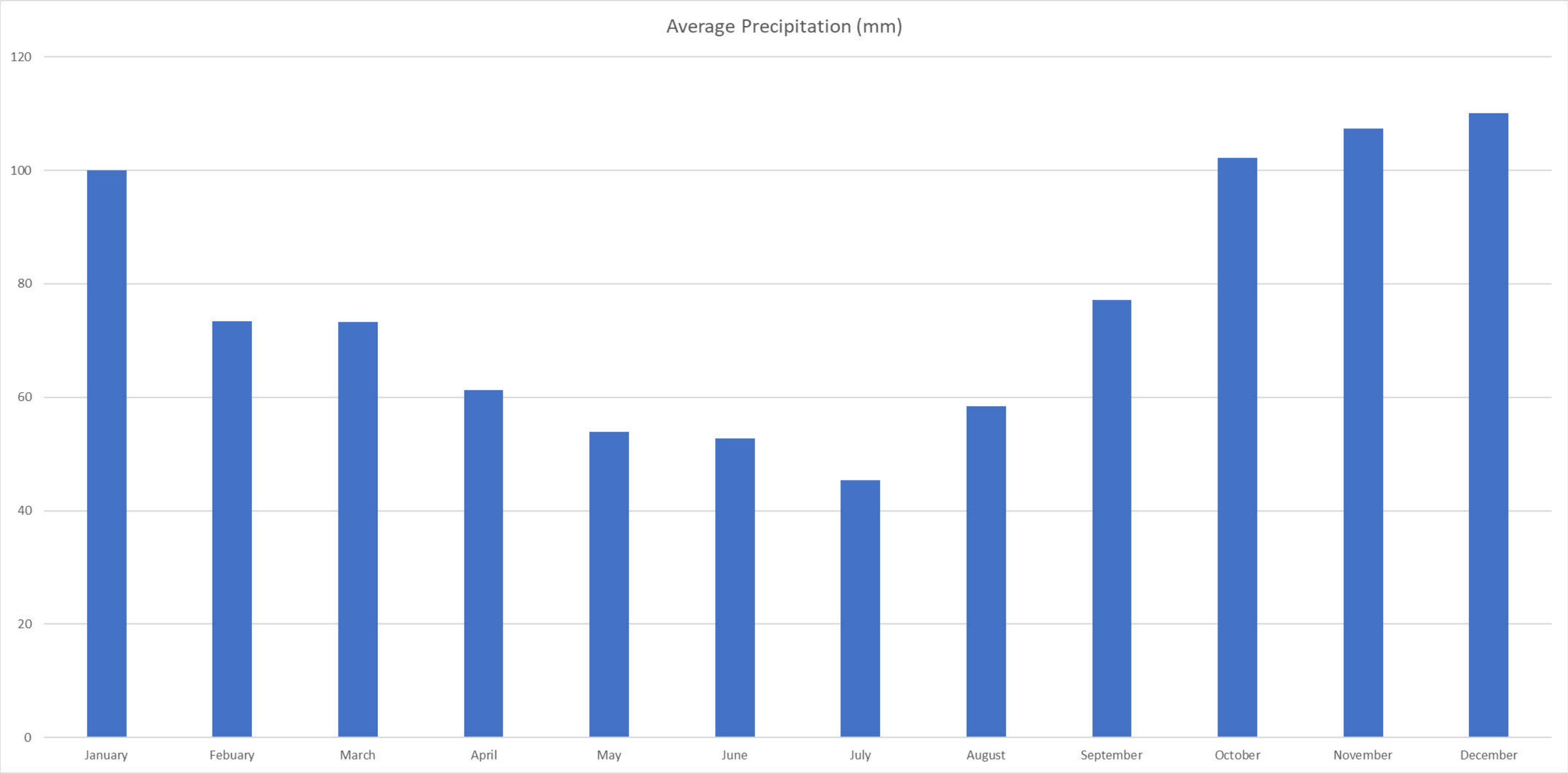


Figure 8 - Average monthly precipitation at the Winfrith Site (1961 - 2004)



7.2.2. Wind Speed and Direction

Wind speed and direction data are obtained from the Met Office climate monitoring station at Hurn, located at grid reference: SZ 11730 97727. The automatic gauging station at Hurn is located approximately 32 km north-east of the Winfrith site.

Prevailing wind directions are considered during activities which are anticipated to produce large volumes of dust. Management plans and mitigation measures will be provided in the detailed Construction Environment Management Plan to be produced alongside the detailed design phase of the project.

7.2.3. Leachate Monitoring

NRS does not anticipate the requirement to install leachate monitoring wells within either the SGHWR or the Dragon deposits to monitor the source.

In the case of the SGHWR and Dragon deposits, it will not be possible to collect leachate from the completed deposits. This is because the boreholes would compromise the integrity of the deposit, and potentially create pathways into the deposit for increased infiltration. Furthermore, the cap will prevent sampling from perched levels within the deposits. Instead, the impact of the deposits and the leachate completion criteria will be assessed based on groundwater quality monitoring.

The material for the backfilling of the reactor basement structures will be generated from decommissioning and demolition of the above ground reactor structures and existing stockpiles at the Site (D630) which have undergone characterisation. All materials will therefore be derived from a single site of origin. As such, in accordance with DfR waste acceptance procedures, the waste to be recovered does not need to be tested (Ref. 29). Significant work has been undertaken to characterise the structures and backfill (Ref. 17) alongside the development and use of robust Emplacement Acceptance Criteria (Ref. 18) regulating the emplacement of materials in the backfill will negate the need for source monitoring.

The HRA (Ref. 3) conducted for the Site included a Tier 3 Detailed Quantitative Risk Assessment (DQRA). The HRA (Ref. 3) sets out the results from this modelling and underpins the applicability and robustness of the result. This is presented in Tables Table 6 and Table 7.

Table 6 - Modelled peak concentration of contaminants in groundwater at the compliance point for the SGHWR in the reference scenario.

Parameter	Peak Concentration (mg/l)	Time of Peak (yr)	Compliance Limit (mg/l)	Compliance Limit / Peak Concentration
PCB-28	9.7E-09	1537	1.0E-06	103
PCB-52	1.5E-09	1530	1.0E-06	69
PCB-101	9.7E-09	1660	1.0E-06	103
PCB-118	2.8E-10	2424	1.0E-06	3588
PCB-138	4.2E-10	2468	1.0E-06	2378
PCB-153	4.8E-11	3280	1.0E-06	20806
PCB-180	3.2E-13	6254	1.0E-06	3150606
Chromium (III)	3.5E-04	1218	4.7E-03	13
Chromium(IV)	3.5E-04	1218	1.0E-03	2.8

Parameter	Peak Concentration (mg/l)	Time of Peak (yr)	Compliance Limit (mg/l)	Compliance Limit / Peak Concentration
Copper	3.0E-06	11812	1.2E-02	4044
Lead	1.3E-06	11747	2.0E-04	156
Zinc	1.0E-05	6475	2.7E-02	2599
C10-C12 Aromatics	6.1E-05	764	1.0E-02	163
C12-C16 Aromatics	1.4E-05	1004	1.0E-02	717
C16-C21 Aromatics	1.8E-05	1048	1.0E-02	560

Table 7 - Modelled peak concentration of contaminants in groundwater at the Dragon reactor compliance point in the reference scenario.

Parameter	Peak Concentration (mg/l)	Time of Peak (yr)	Compliance Limit (mg/l)	Confidence Factor (Compliance Limit / Peak Concentration)
PCB-28	4.8E-08	1204	1.0E-06	20.9
PCB-52	6.9E-08	1201	1.0E-06	14.5
PCB-101	8.9E-08	1251	1.0E-06	11.3
PCB-118	1.7E-08	1355	1.0E-06	60.4
PCB-138	2.7E-08	1358	1.0E-06	37.2
PCB-153	1.1E-08	1409	1.0E-06	92.3
PCB-180	2.2E-09	1608	1.0E-06	448
Chromium (III)	2.2E-04	589	4.7E-03	21
Chromium(IV)	2.2E-04	589	1.0E-03	4.5
Copper	6.5E-07	1092	1.2E-02	18501
Lead	4.2E-07	3569	2.0E-04	471
Zinc	1.9E-06	1037	2.7E-02	13869

As the backfill materials are derived from a single origin, the characterisation and backfilling process can be tightly controlled. The EAC and CQAP will ensure only compliant materials are used in backfilling, therefore leachate monitoring wells are not required in accordance with EA guidance. This is furthered through the results of the DQRA (Ref. 3) providing reassurance through large safety factors for contaminants of concern; signifying limited modelled contaminant breakout into groundwater.

Owing to the use of worst case contaminant concentrations, and adherence to the more stringent acceptance criteria of the EAC, breakthrough of contaminants into groundwater is likely to be of a lower concentration than thoset presented in Table 7. Thereby, an increased confidence factor between contaminant concentrations and compliance limits will occur..

7.3. Gas Monitoring

7.3.1. <u>Gas Production</u>

Microbial Activity and Biodegradation of organic wastes
The Emplacement Acceptance Criteria (EAC) for the Winfrith deposits (Ref. 18) stipulates the chemical, physical and biological characteristics of the material that is allowed to be emplaced

into the deposit. The EAC stipulates chemical, physical and biological properties that materials in the structure, materials used in any reinstatement or engineering works and demolition materials to be used as infill material will have to abide by. The physical characteristics of the EAC (EAC1) sets the physical criteria to allow materials to remain in place or be emplaced. Generally, concrete and bitumen can remain in-situ or be emplaced. Similarly fibreglass present in liners can remain due to its chemically inert properties. Concrete with bitumen liners, where the bitumen contains coal tar concentrations less than 0.1 wt% can be considered for emplacement as it has been assessed through a BAT assessment and detailed analysis completed. Plasterboard materials must be removed from the structure prior to demolition and backfilling operations.

EA guidance (Ref. 19) stipulates that for wastes from a single source of low organic content, gas monitoring will not normally be required where waste acceptance records and analysis is available.

The EAC additionally stipulates criteria for the maximum permitted concentrations of organic materials to be emplaced within the deposits. Whilst the EA guidance (Ref. 19) does not define criteria for low organic content materials, the concentrations of organic materials are demonstrably low as the operational history of the reactors is well understood and a substantial amount of decommissioning has increased knowledge of facility characteristics. The modelled risk to groundwater set out in the HRA (Ref. 3) are conservative and assume higher concentrations of organic contaminants than is allowed for in the EAC. The HRA and EA therefore demonstrates that EA guidance can be met.

Table 8 - Maximum concentrations of organic contents (Ref. 18)

Parameter	Maximum concentration (mg/kg dry material)
Total organic carbon (TOC)	30,000
Dissolved organic carbon (DOC)	500
Benzene, toluene, ethylbenzene and xylenes (BTEX)	6
Polychlorinated biphenyls, 7 congeners (PCBs)	1
Mineral oil (C10 to C40)	500
Polycyclic aromatic hydrocarbons (PAHs)	100

7.3.2. Gas production from metal corrosion

Corrosion of metal leading to gas production will not pose undue risk.

There will be limited amounts of metals remaining in the completed deposits. The EAC (Ref. 18) stipulates that encast metals, rebar and metals which are required for structural stability or would be challenging to remove can remain in situ. This approach has been assessed through an optimisation process. There is expected to be low quantities of metal remaining, the majority of which is already case into concrete.

Where encast and structural metals can be removed without compromising structural integrity, these will be removed. The EAC also states that all metallic wiring and associated cable trays (Ref. 18) will be removed from the buildings.

In addition to the limited amounts of metals, the conditions inside the deposits are not suitable for hydrogen generation.

Due to the backfill materials being derived from demolition arisings (concrete and brick) and concrete blocks, the deposits will have an alkaline environment. Under alkaline environments, the corrosion of iron and steel will produce only hydrogen gas in anaerobic conditions (Ref. 20) in line with the chemical reaction:

$$3Fe + 4H_2O = Fe_3O_4 + 4H_2$$

Under aerobic conditions the corrosion of iron does not produce hydrogen gas.

Since the conditions in the deposit will be aerobic, there should be limited to no hydrogen production from metal corrosion.

7.3.3. In-Waste Gas Monitoring

The Environment Agency guidance on Aftercare and Permit Surrender for landfills and deposit for recovery operations (Ref. 19), states that permanent monitoring points must be installed into the waste to provide evidence that the operation has an acceptable impact on land, air and people. Gas monitoring must be installed where the risk assessment shows that the intention is to deposit waste more than 2 metres below ground surface and if the waste is likely to produce gas. It also states that landfill gas produced by the degradation of waste in the site and other gases produced, such as hydrogen sulphide gases are to be monitored and have necessary measures in place to manage these gases unless they are unlikely to cause pollution.

The EAC, appropriate characterisation, segregation and sorting will ensure that non-compliant materials are removed. Therefore, in-waste monitoring is not required or justified for the Winfrith deposit activities.

7.3.4. External Gas Monitoring

It is anticipated that alongside in-waste gas monitoring not being required for the Winfrith deposits, that external gas monitoring will also not be required. The waste source will be from on-site demolition arisings that can be effectively characterised and controlled. Furthermore, through robust EAC and characterisation will limit deposits to inert waste with no significant potential for a gas production mechanism.

The Environment Agency Guidance on Aftercare and Permit Surrender (Ref. 19) states that if landfill gas is found within the Site, then considerations must be made over the likelihood of gas migrating outside the site boundary.

Given that there will be no generation of gas due to the wastes being deposited, the risks associated with migration of gas are also not considered to be significant. Inputs into the deposits will be recorded, ensuring compliance with the emplacement acceptance criteria. Records will be held and maintained in accordance with the record retention schedule, alongside those of the radioactive waste permit.

7.3.5. Surface Monitoring

Visual inspections of the cap from routine walkover survey’s will be used to identify defects or burrows from animals as specified in the Environmental Monitoring Plan (Ref. 21).

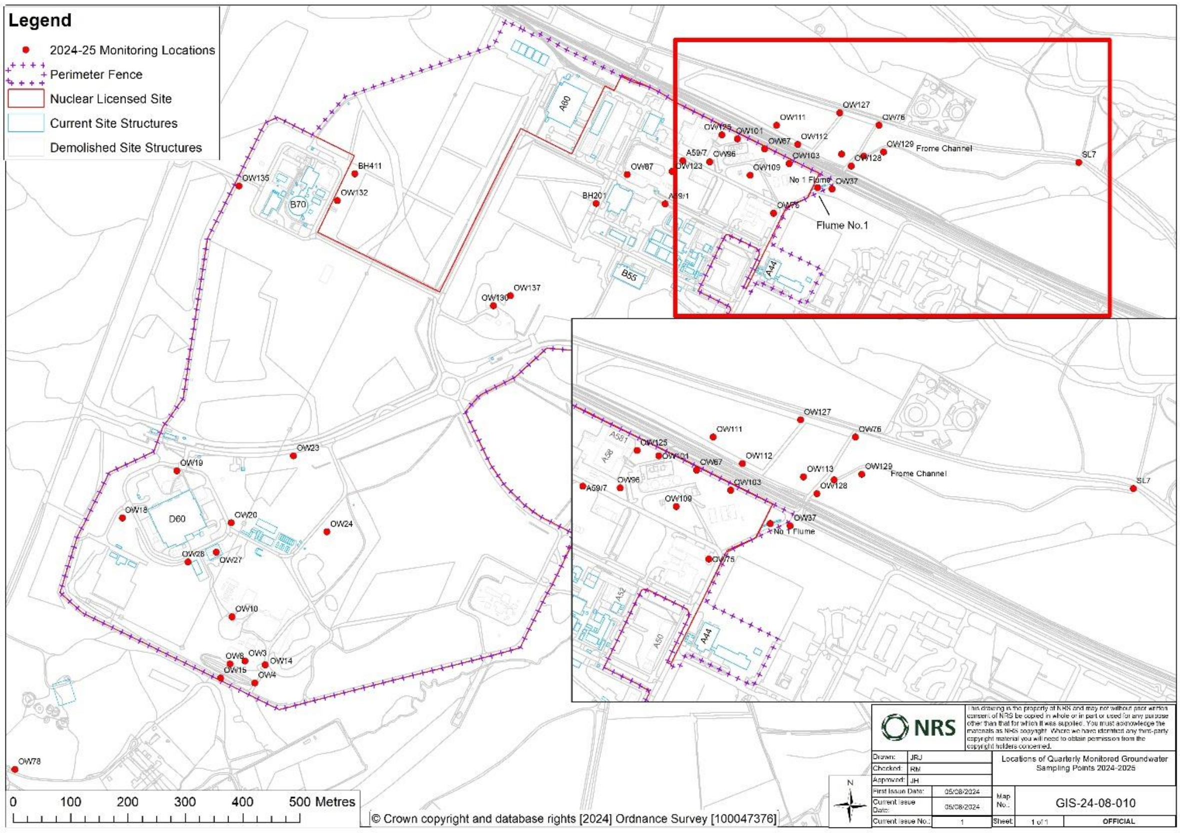
Negligible concentrations of H_2S and CH_4 are anticipated to be produced from the deposit. Therefore, periodic walkover surveys of the cap surface using a Flame Ionisation Detector (FID) or equivalent will not be required or undertaken.

7.4 Groundwater Monitoring Infrastructure

The Winfrith Site has a robust and extensive network of groundwater monitoring boreholes. These are presented in the Stewardship Plan (Ref. 16) which sets out the locations of boreholes that are presently being monitored at the Site, as well as the locations of boreholes to support groundwater monitoring of the deposits from implementation through aftercare to the SRS.

Locations of current groundwater monitoring infrastructure are presented in Figure 9.

Figure 9 - Current groundwater monitoring infrastructure at the Winfrith Site



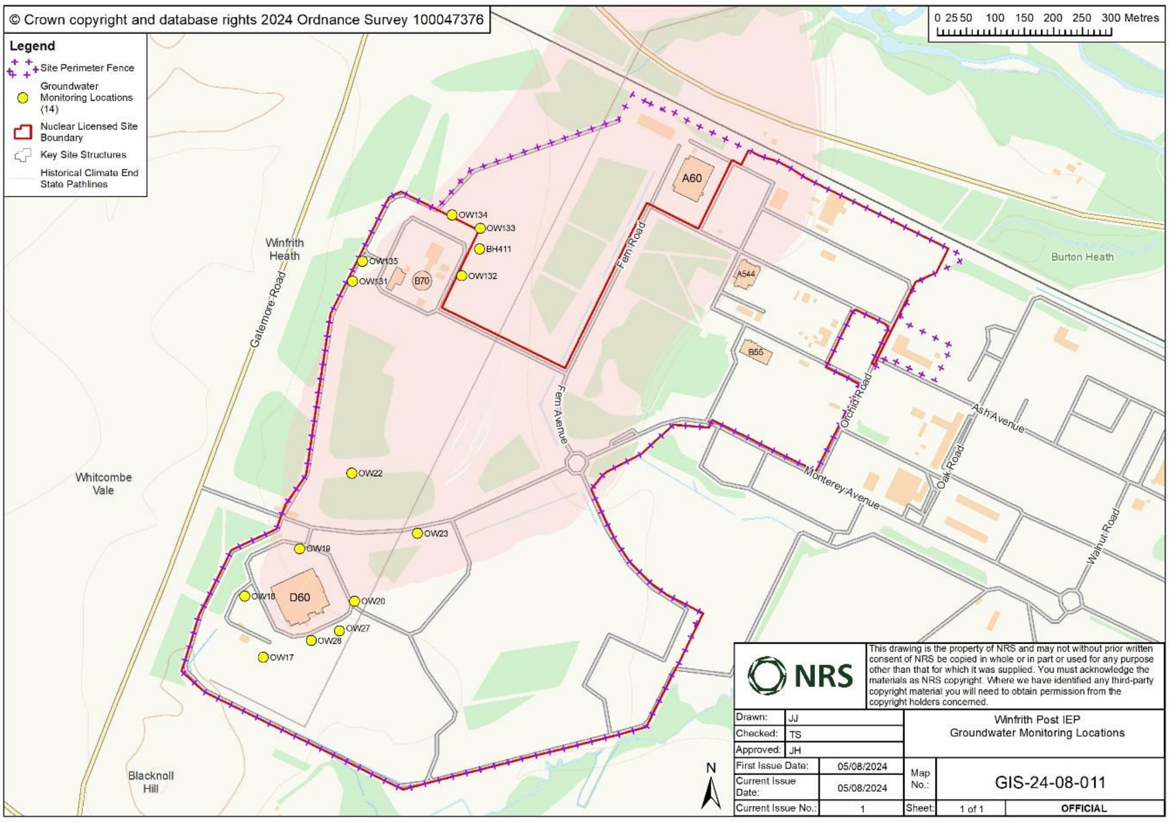
Groundwater monitoring boreholes on the Site are currently utilised to support on-going remediation activities. The Stewardship Plan (Ref. 16) sets out the groundwater monitoring boreholes that will be used through the aftercare period to validate the performance of the SGHWR and Dragon end states from the point deposits are completed through to the SRS.

The proposed groundwater monitoring boreholes to be used until the SRS are presented in Figure 10. These locations meet the Environment Agency minimum requirements for landfill groundwater monitoring locations of:

- At least one upgradient groundwater monitoring point to monitor background groundwater quality; and
- At least two downgradient groundwater monitoring point to monitor the outflow region.

Following the landfill operators guidance, the monitoring requirements are centred around the two proposed deposits of SGHWR and Dragon, with upgradient, downgradient and cross-gradient groundwater monitoring boreholes. These boreholes are sufficient to monitor the performance of the two Deposit for Recovery operations planned at the Site.

Figure 10 - Proposed groundwater monitoring borehole locations following IEP to SRS



Prior to the IEP, boreholes will be progressively decommissioned in accordance with EA guidance when no longer required.

7.4. Groundwater Monitoring

7.4.1. Construction Phase

During construction of the deposits, the current groundwater monitoring programme at the site will be used to monitor deviation from the established baseline, as set out in the Stewardship Plan (Ref. 16). The Winfrith Site has a robust monitoring network of 44 boreholes sampled on a quarterly basis to support site restoration and a further 90 boreholes currently available. This network of boreholes along with the currently monitored analyses will continue up to the site IEP to support on-going remediation activities. The current analytical suite is presented below:

- Chemical Species: metals, Volatile Organic Compounds (VOCs), Major Ions, pH and Total Petroleum Hydrocarbons- Criteria Working Group (TPH-CWG);
- Radioactive Species: Gross alpha, gross beta, tritium.

Additional monitoring requirements to support the construction of the deposits may be provided through the Construction Environmental Management Plan.

7.4.2. Post construction of the Deposits

Following the construction of the deposit, the focus of monitoring will address the performance of the DfR activities, alongside the radioactive waste disposals, to enable progression towards the surrender of the permit.

The groundwater monitoring requirements following the construction of the deposits to SRS are presented in the EMP (Ref. 21).

The following monitoring locations are proposed for the deposit for recovery activities at SGHWR and Dragon:

- OW17 and OW18 upgradient of SGHWR;
- OW19, OW20 and OW138 immediately downgradient of SGHWR;
- OW27 and OW28 in the immediate vicinity of SGHWR;
- OW44 downgradient of SGHWR and at area of groundwater emergence, upgradient of the mire receptor;
- OW131 and OW135 upgradient of Dragon; and
- OW132, OW133, OW134 and BH411 downgradient of Dragon.

Sampling and analysis protocols for the groundwater samples obtained post-deposit are presented in the EMP (Ref. 21). The EMP (Ref. 21) outlines the rationale behind the selection of the determinands to be analysed as outlined below:

- Gross alpha*;
- Gross beta*;
- Tritium*;
- Gamma spectrometry*;
- 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, nitrate, total alkalinity.

* Whilst radiological determinants are not required to be monitored under DfR permit conditions, they have been included here for completeness.

The monitoring will be undertaken to generate sufficient amounts and quality of data to capture operational and aftercare performance and support eventual permit surrender. As the deposits are not an engineered for purpose construction, compliance and verification monitoring will ensure an appropriate assessment of performance can be made. The groundwater quality data obtained will be used to inform:

- That the pollution control systems are working appropriately; and
- Leachate emissions from the deposits to groundwater are acceptable and within the boundaries set in the appropriate risk assessment.

7.4.3. Groundwater Compliance Limits

Groundwater compliance limits for the period monitoring the performance of the deposits are presented in Table 9.

Table 9- Groundwater Action Level and Compliance Limits for contaminants during the deposit performance verification monitoring

Determinand	Investigation Level (µg/l)	Compliance Limit (µg/l)
pH	8	8
As	6	5
Ba	325	1300
Cd	0.02	0.08
Cr (VI)	1.25	5
Cu	12	12
Hg	0.4	0.01
Mo	17.5	70

Ni	15	15
Pb	3	0.2
Sb	1.25	5
Se	2.5	10
Zn	27	27

Note: Action Levels have been selected as a site-based compliance concentration to ensure no discernible impacts from the deposits and disposals. Action Levels highlighted in red denote determinands where background groundwater quality exceeds respective Compliance Limits.

For As, Hg and Pb the upgradient backgrounds (Ref. 3) are higher than the compliance limit. Therefore, exceedances of the natural background will be used as the action level. Using a compliance limit or another action level would not be practicable.

7.5. Surface Water Monitoring

Through the construction of the deposits, and the aftercare period until the SRS, there is no planned surface water monitoring to be undertaken.

The only potential pathway for contaminants to enter the River Frome is through groundwater inputs. Groundwater flowlines from the SGHWR and Dragon reactors are presented in Figure 11. The flowlines illustrate that any potential contaminants travelling towards the surface water compliance point of the River Frome must travel through groundwater, and therefore would be detected through the groundwater monitoring network.

The Conceptual Site Model (Ref. 5) assumes a hydraulic conductivity for the Poole Formation of 2.7×10^{-04} m/s. Since the distance between the Dragon deposit and the River Frome is approximately 600 m, this would result in a travel time in the order of 1,029 days:

$$v = \frac{k \, . \, i}{\emptyset}$$

Where:

V = groundwater velocity (m/s)

k = hydraulic conductivity (m/s)

i = hydraulic gradient

∅ = porosity

This is calculated using a Hydraulic Conductivity of 2.7×10^{-4} m/s (Ref. 5), a hydraulic gradient of 0.005 (Ref. 4) and a porosity of 0.2 (Ref. 4).

Due to flow rates and dilution factors within the River Frome and the anticipated inputs from groundwater, it is not expected that surface water monitoring would be effective at detecting any potential contaminant input into the River Frome.

On the basis of the this, and through wide coverage of the groundwater pathway, surface water monitoring has been excluded from the proposed monitoring requirements. If contaminant concentrations in groundwater exceed their respective Action Level then appropriate investigation of the cause and potential further work will be undertaken.

Figure 11: Groundwater flowlines and modelled contaminant seeds

7.5 Amenity Monitoring

Amenity monitoring and management of their respective control measures, such as dust suppression, noise, and vibrations are presented in the CEMP.

Management and monitoring arrangements presented in the CEMP (Ref. 34) are based on the existing management system requirements that support large scale nuclear demolitions across the UK decommissioning estate. The CEMP is a living document with a series of iterations planned, not least this version (application) and a second issue following detailed design to incorporate any specific planning or permit conditions.

It is foreseen that management controls will evolve through the detailed design of the demolition of the facilities is undertaken in tandem with an appointed demolition contractor. Furthermore, updates are anticipated following detailed design of the construction of the deposit facilities.

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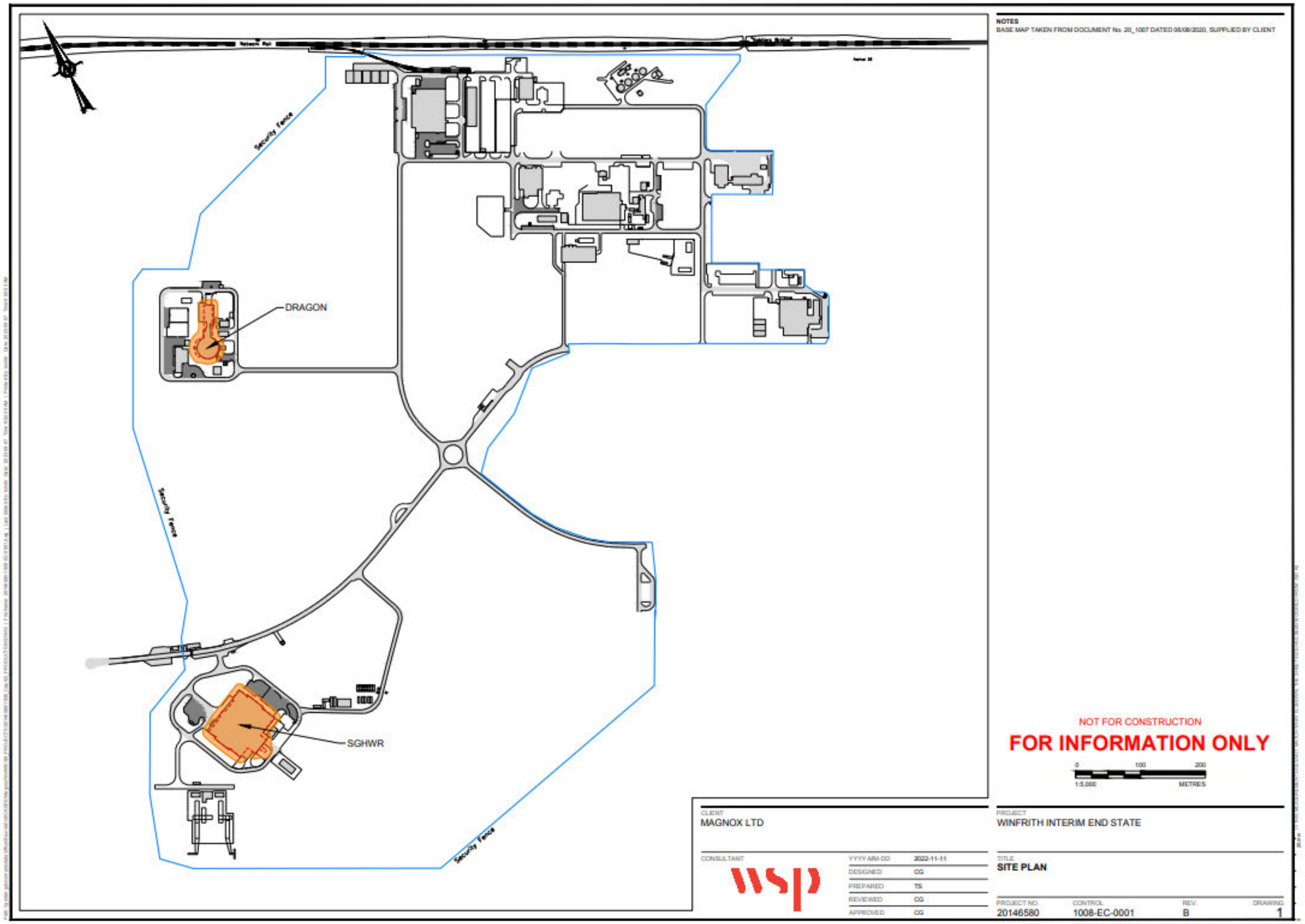
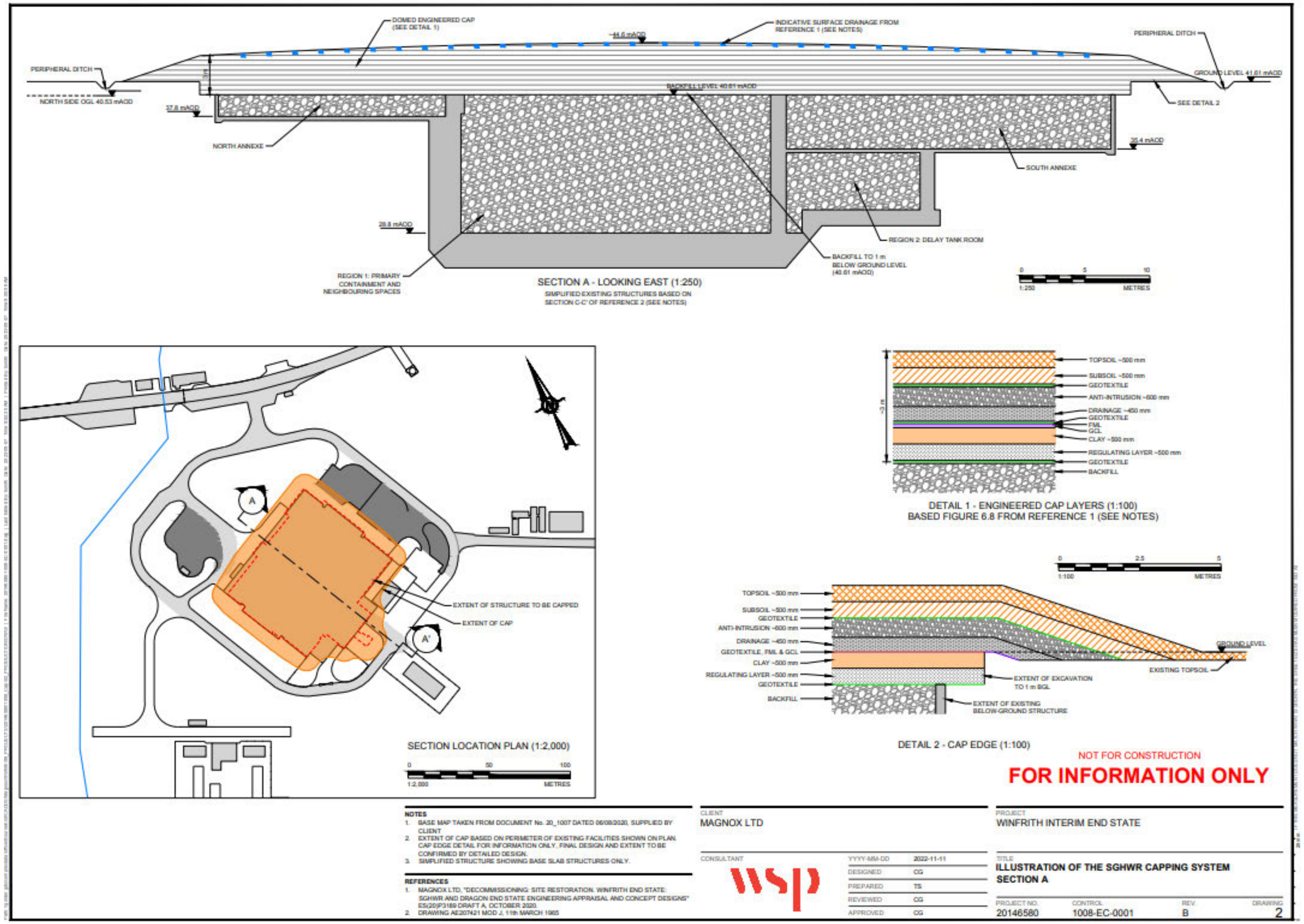
Appendix A – Provisional Cap Design Drawings

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GROUND LEVEL 41.61 mAOD
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BACKFILL LEVEL 40.61 mAOD
SEE DETAIL 2
NORTH ANNEXE
SOUTH ANNEXE
REGION 2: DELAY TANK ROOM
BACKFILL TO 1 m BELOW GROUND LEVEL (40.61 mAOD)
REGION 1: PRIMARY CONTAINMENT AND NEIGHBOURING SPACES
SECTION A - LOOKING EAST (1:250)
SIMPLIFIED EXISTING STRUCTURES BASED ON SECTION C-C' OF REFERENCE 2 (SEE NOTES)
METRES
TOPSOIL ~500 mm
SUBSOIL ~500 mm
GEOTEXTILE
ANTI-INTRUSION ~600 mm
DRAINAGE ~450 mm
FML
GCL
CLAY ~500 mm
REGULATING LAYER ~500 mm
BACKFILL
DETAIL 1 - ENGINEERED CAP LAYERS (1:100)
BASED FIGURE 6.8 FROM REFERENCE 1 (SEE NOTES)
EXTENT OF STRUCTURE TO BE CAPPED
EXTENT OF CAP
GEOTEXTILE, FML & GCL
GROUND LEVEL
EXISTING TOPSOIL
EXTENT OF EXCAVATION TO 1 m BGL
EXTENT OF EXISTING BELOW-GROUND STRUCTURE
SECTION LOCATION PLAN (1:2,000)
DETAIL 2 - CAP EDGE (1:100)
NOT FOR CONSTRUCTION
FOR INFORMATION ONLY
NOTES
1. BASE MAP TAKEN FROM DOCUMENT No. 20_1007 DATED 06/08/2020, SUPPLIED BY CLIENT
2. EXTENT OF CAP BASED ON PERIMETER OF EXISTING FACILITIES SHOWN ON PLAN. CAP EDGE DETAIL FOR INFORMATION ONLY, FINAL DESIGN AND EXTENT TO BE CONFIRMED BY DETAILED DESIGN.
3. SIMPLIFIED STRUCTURE SHOWING BASE SLAB STRUCTURES ONLY.
REFERENCES
1. MAGNOX LTD, "DECOMMISSIONING: SITE RESTORATION. WINFRITH END STATE: SGHWR AND DRAGON END STATE ENGINEERING APPRAISAL AND CONCEPT DESIGNS" ES(20)P3189 DRAFT A, OCTOBER 2020.
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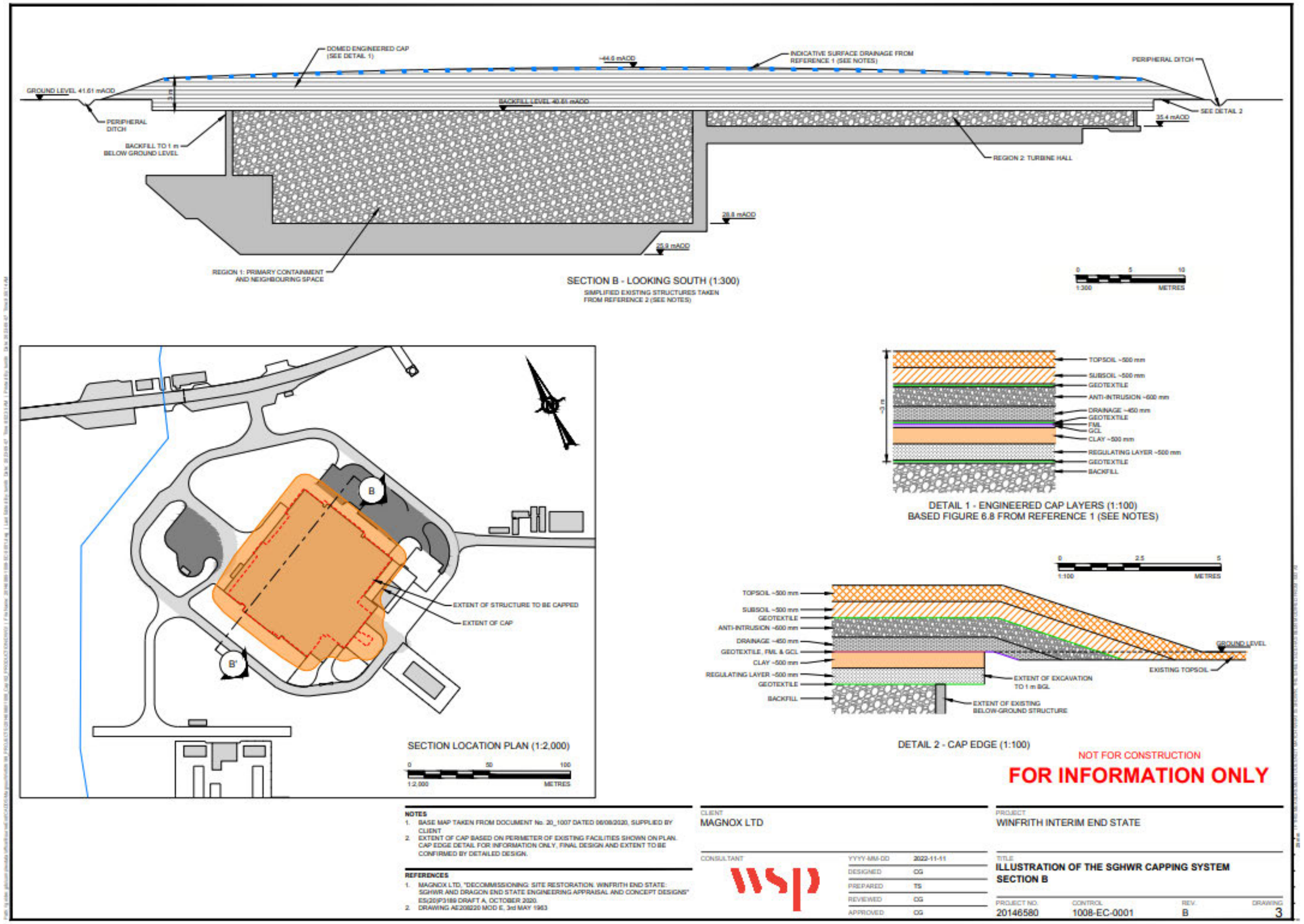
PROJECT NO. 20146580
CONTROL 1008-EC-0001
REV B
DRAWING 2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BACKFILL LEVEL 40.61 mAOD
PERIPHERAL DITCH
BACKFILL TO 1 m BELOW GROUND LEVEL
SEE DETAIL 2
35.4 mAOD
REGION 2: TURBINE HALL
28.8 mAOD
25.9 mAOD
REGION 1: PRIMARY CONTAINMENT AND NEIGHBOURING SPACE
SECTION B - LOOKING SOUTH (1:300)
SIMPLIFIED EXISTING STRUCTURES TAKEN FROM REFERENCE 2 (SEE NOTES)
0 5 10
1:300 METRES
TOPSOIL ~500 mm
SUBSOIL ~500 mm
GEOTEXTILE
ANTI-INTRUSION ~600 mm
DRAINAGE ~450 mm
GEOTEXTILE
FML
GCL
CLAY ~500 mm
REGULATING LAYER ~500 mm
GEOTEXTILE
BACKFILL
~3 m
DETAIL 1 - ENGINEERED CAP LAYERS (1:100)
BASED FIGURE 6.8 FROM REFERENCE 1 (SEE NOTES)
B
B'
EXTENT OF STRUCTURE TO BE CAPPED
EXTENT OF CAP
0 2.5 5
1:100 METRES
TOPSOIL ~500 mm
SUBSOIL ~500 mm
GEOTEXTILE
ANTI-INTRUSION ~600 mm
DRAINAGE ~450 mm
GEOTEXTILE, FML & GCL
CLAY ~500 mm
REGULATING LAYER ~500 mm
GEOTEXTILE
BACKFILL
GROUND LEVEL
EXISTING TOPSOIL
EXTENT OF EXCAVATION TO 1 m BGL
EXTENT OF EXISTING BELOW-GROUND STRUCTURE
SECTION LOCATION PLAN (1:2,000)
0 50 100
1:2,000 METRES
DETAIL 2 - CAP EDGE (1:100)
NOT FOR CONSTRUCTION
FOR INFORMATION ONLY
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REFERENCES
1. MAGNOX LTD, "DECOMMISSIONING: SITE RESTORATION. WINFRITH END STATE: SGHWR AND DRAGON END STATE ENGINEERING APPRAISAL AND CONCEPT DESIGNS" ES(20)P3189 DRAFT A, OCTOBER 2020.
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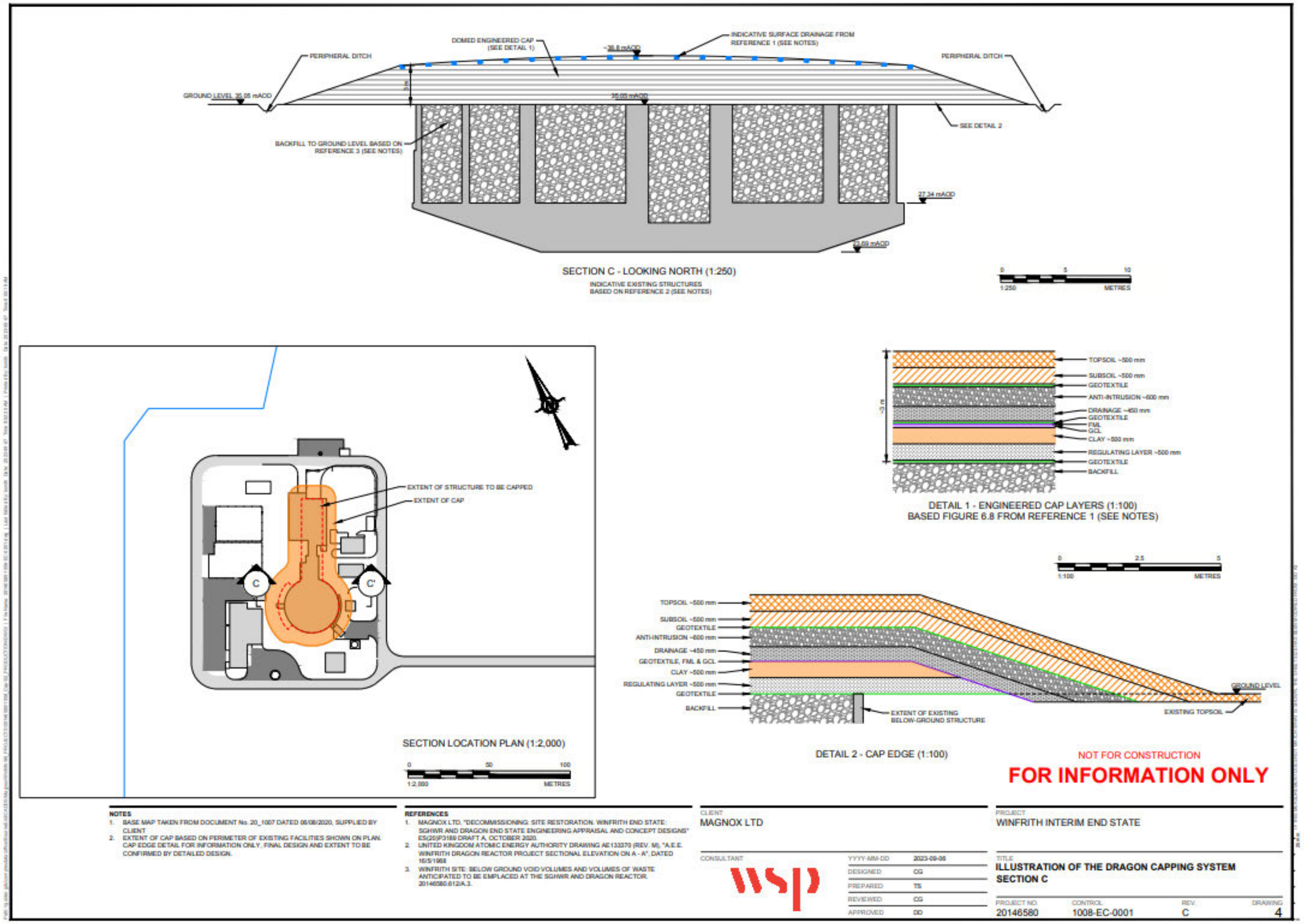
PROJECT NO. 20146580
CONTROL 1008-EC-0001
REV. B
DRAWING 3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SECTION C - LOOKING NORTH (1:250)
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ANTI-INTRUSION ~600 mm
DRAINAGE ~450 mm
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FML
GCL
CLAY ~500 mm
REGULATING LAYER ~500 mm
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BACKFILL
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BASED FIGURE 6.8 FROM REFERENCE 1 (SEE NOTES)
EXTENT OF STRUCTURE TO BE CAPPED
EXTENT OF CAP
SECTION LOCATION PLAN (1:2,000)
1:2,000
METRES
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SUBSOIL ~500 mm
GEOTEXTILE
ANTI-INTRUSION ~600 mm
DRAINAGE ~450 mm
GEOTEXTILE, FML & GCL
CLAY ~500 mm
REGULATING LAYER ~500 mm
GEOTEXTILE
BACKFILL
EXTENT OF EXISTING BELOW-GROUND STRUCTURE
GROUND LEVEL
EXISTING TOPSOIL
DETAIL 2 - CAP EDGE (1:100)
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REFERENCES
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3. WINFRITH SITE: BELOW GROUND VOID VOLUMES AND VOLUMES OF WASTE ANTICIPATED TO BE EMPLACED AT THE SGHWR AND DRAGON REACTOR. 20146580.612/A.3.
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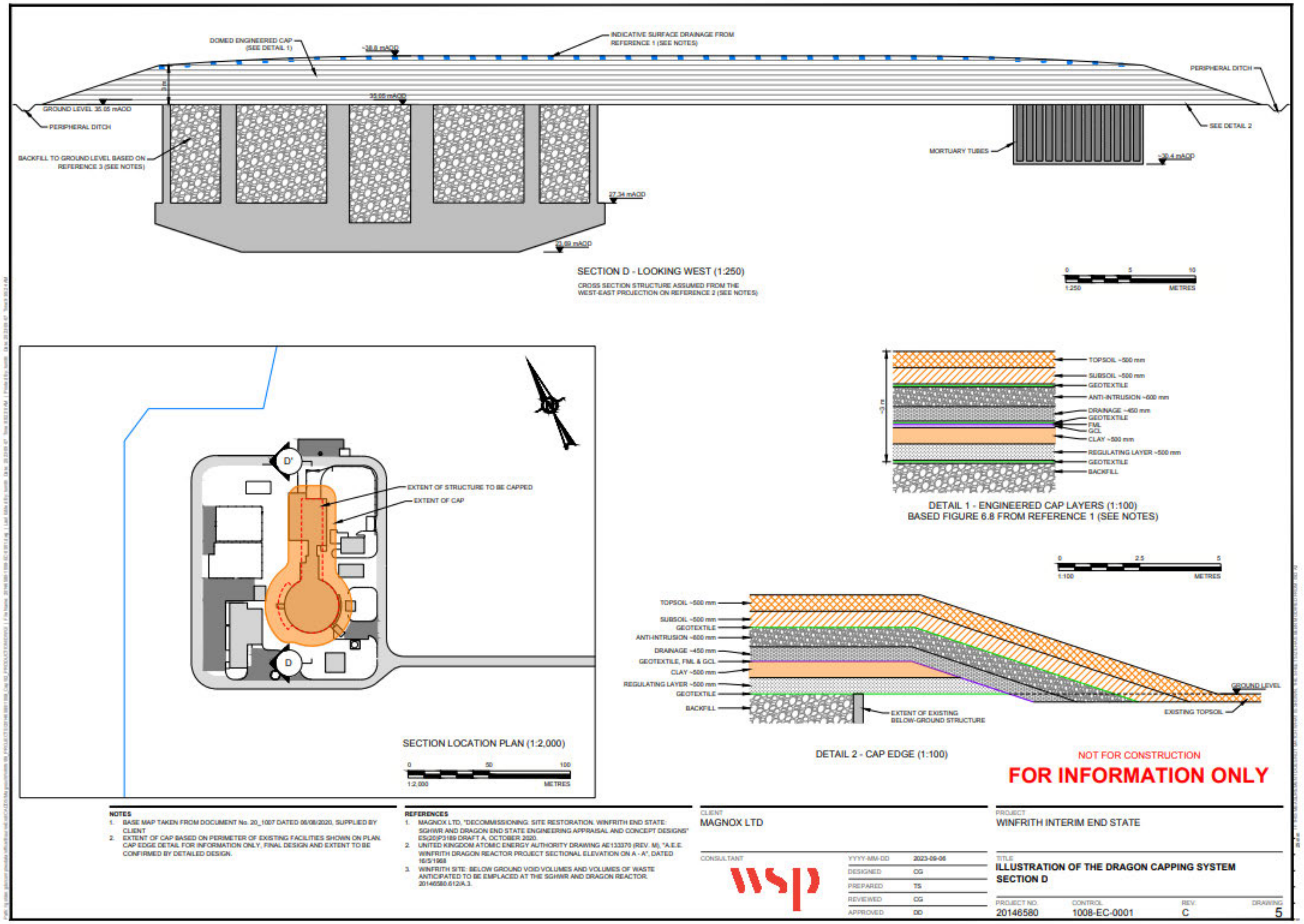
CONTROL 1008-EC-0001
REV. C
DRAWING 4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EXTENT OF CAP
D'
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GEOTEXTILE
ANTI-INTRUSION ~600 mm
DRAINAGE ~450 mm
FML
GCL
CLAY ~500 mm
REGULATING LAYER ~500 mm
BACKFILL
DETAIL 1 - ENGINEERED CAP LAYERS (1:100)
BASED FIGURE 6.8 FROM REFERENCE 1 (SEE NOTES)
GEOTEXTILE, FML & GCL
EXTENT OF EXISTING BELOW-GROUND STRUCTURE
GROUND LEVEL
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FOR INFORMATION ONLY
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2. EXTENT OF CAP BASED ON PERIMETER OF EXISTING FACILITIES SHOWN ON PLAN. CAP EDGE DETAIL FOR INFORMATION ONLY, FINAL DESIGN AND EXTENT TO BE CONFIRMED BY DETAILED DESIGN.
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2. UNITED KINGDOM ATOMIC ENERGY AUTHORITY DRAWING AE133370 (REV. M), "A.E.E. WINFRITH DRAGON REACTOR PROJECT SECTIONAL ELEVATION ON A - A", DATED 16/5/1968
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TITLE
ILLUSTRATION OF THE DRAGON CAPPING SYSTEM
SECTION D
PROJECT NO. 20146580
CONTROL 1008-EC-0001
REV. C
DRAWING 5

Appendix B- Compliance With Environmental Permit

NRS
Nuclear Restoration Services

Document Ref:- EHSSQ/24/00737	Note For the Record
Title: Report of Winfrith Compliance With its Environment Permit	Page 1 of 3
	Issue: 1
	Date: June 2024

	Name	Signature	Job Title	Date
Author:	Lisa Hayward	LHayward	Environment Engineer	20/06/24
Approver:	Laura Brearley	Laura Brearley	Head of Environment	3/7/2024

1. INTRODUCTION

Winfrith NRS site undertakes its radioactive substances operations under a licence issued by the Office of Nuclear Regulation (ONR) [ref: 1] and a permit issued by the Environment Agency (EA) [ref: 2]. The permit is supported by a Compilation of Environment Agency Requirements and Specifications (CEARAS) document [ref: 3].

The permit issued by the EA stipulates various conditions that the operators of the Winfrith site, NRS, must abide by. If these conditions are not met, this is deemed as a non-compliance and regulatory action could be taken. Winfrith site have experienced some events that have led to non-compliances, resulting in warning letters and also details of non-compliances on a number of Radioactive Substances Regulations Compliance Assessment Reports (RASCARs).

This document details the non-compliances that the Winfrith site has experienced.

2. DETAILS OF NON-COMPLIANCES

The EA complete regular quarterly inspections against aspects of the permit. The area to be inspected is predetermined and identified in the Site Environmental Review. Few non-compliances have been identified during inspections. A report of the inspection is received in the form of a RASCAR, detailing any non-compliances if necessary.

The majority of non-compliances that have occurred have been the result of an event on the site. Following an event, the EA would be notified, and an investigation carried out to determine the causal factors and correct any findings. This investigation report would be sent to the EA and they would use this information, along with other communications and site visits if required, to raise a RASCAR, detailing the permit conditions breached.

The table on the next page shows details of events or issues that have occurred that have resulted in a breach of the permit and a non-compliance, categorised using the EA's compliance classification scheme (CCS).

Date of Event	Event	Condition Breached	CCS Rating
2008	Deficiencies in analysis methods *Warning letter received*		
2009	Exceedance of zinc limit in the permit for water discharge		3
2009	Exceedance of zinc limit in the permit for water discharge		3
2010	Exceedance of free chlorine limit in the permit for water discharge		3
2010	Exceedance of free chlorine limit in the permit for water discharge		3
2010	Records not being kept in the specified location in the CEAR		4
2010	Incorrect records being provided by RSRL covering transfers of radioactive waste from RSRL Winfrith to Inutec (Jan 2007 - May 2010) *Warning letter received*		4
2013	Concrete shielding blocks being transported from site as non-radioactive waste but were identified as contaminated by the site's vehicle monitor *Warning letter received*		3
			4
05/02/2014	SGS Transmission source not fully opening resulting in over-estimates of drum activities.	2.3.5	4
15/05/2014	ISO of metal sent to Germany for treatment, with incorrect weight assigned.	1.1.1(a)	4
		3.1.5	4
03/12/2014 – 03/12/2014	Failure of an air release valve on a pump at Shore Valve House resulted in effluent overflowing the bund and a release onto the foreshore.	1.1.1(b)	3
		3.1.1	3
07/09/2015	Drum of waste emitted liquor on supercompaction.	1.1.1(b)	4
		3.1.5	4
04/10/2016	Metal pipe identified in incinerator ash.	1.1.1(a)	3
		3.1.5	4

Date of Event	Event	Condition Breached	CCS Rating
23/08/2017	Error in consignment spreadsheet resulted in the activity declared being greater than actually present for three consignments.	1.1.1(a)	3
		1.1.1(b)	4
		3.1.5	4
27/03/2019	Break identified in effluent pipe from building B70 to B76 delay tank.	1.1.1(a)	3
		2.3.2(c)	4
		2.3.5	4
22/05/2019	Incorrect consignment despatched to Augean. *A joint ONR Enforcement Letter and EA Warning Letter, and also a RASCAR, was received by Magnox for this event.*	1.1.1(a)	3
		1.1.1(b)	4
		3.1.5	4
25/02/2021	Errors identified in the Pollution Inventory submitted to the EA for 2019 reporting year, and late submission of the 2020 Pollution Inventory.	1.1.1	4

3. GENERAL COMMENTS

Since 2008, there have been a number of minor non-compliances identified against the permit for the Winfrith site.

There have been four non-compliances (in 2008, 2010, 2013, and 2019) that resulted in regulatory action in the form of a warning letter.

There have been no non-compliances that have resulted in more severe action.

All non-compliances have been resolved following interactions with the Environment Agency, and the site remains in compliance with its Environmental Permit.

4. REFERENCES

1. ONR Nuclear Site Licence Number 100A, date granted 01/01/1990.
2. Environment Agency Permit number EPR/PB3898DC, effective date 11/02/2019.
3. Compilation of Environment Agency Requirements, Approvals and Specifications, Issue 4, effective date 01/07/2021.