



Research Sites Restoration Ltd

Lifetime Plan Baseline - March 2011

Issue 1

Harwell Site Summary

Site Overview

Steady decommissioning progress since the 1990s has achieved the following:

- Retrieving and repackaging radioactive wastes.
- Providing new facilities for processing and storing radioactive waste.
- Decommissioning radioactive facilities.
- Remediating radioactively and chemically contaminated land.
- Demolishing redundant buildings.
- Delicensing large areas of the site.

Completion of decommissioning allows the transfer of land to the Harwell Oxford Campus where it will become part of the government’s initiative to create a world-class centre of excellence in science and technology.



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Figure 12-01 – Site key facts

Basics	Location	Oxfordshire
	Nearby towns/cities	Didcot, Newbury, Oxford, Reading
	Site Area	113.5 hectares
	Number of current employees	204 (excluding support staff)
Key dates	Waste Encapsulation Plant Operational	2014
	Historic arisings of intermediate level waste (ILW) passively safe or transferred off-site.	2021
	All reactors decommissioned	2031
	Export Facility operational	2043
	Vault Store emptied	2048
	Harwell ILW Store emptied	2060
	Site closure completed	2064
Plant description	B462 Waste Management Facility	Processing and storage of solid intermediate level waste (ILW) and low level waste (LLW) prior to transfer off-site
	LETP - Liquid Effluent Treatment Plant	Treatment of low-level active liquid waste and processing of legacy tank sludges
	B459 - Active Handling Facility	Care and maintenance, excluding one operational cell which is used for repackaging of ILW sources
	B220 - Radiochemical Facility	Processing, repackaging and temporary storage of ILW
	BEPO/H10 Complex	Care and maintenance of BEPO reactor and associated facilities
	Material Testing Reactors (MTRs)	Care and maintenance of DIDO and PLUTO reactors
	Western Storage Area (WSA)	Groundwater remediation plant operations
	Minor Facilities	Decommissioning of other buildings
Unique factors	Established in 1946 as the Atomic Energy Authority Research Establishment, Harwell was the first site in Britain to house nuclear research reactors and facilities.	
	RSRL's decommissioning programme enables the Government's plan of creating a world class science park on the Harwell Oxford Campus.	

Site history

The Harwell site, originally an RAF station, became the Atomic Energy Research Establishment, in 1946. Most of the nuclear reactors and research facilities on site were built between 1946 and 1960. Operations continued until the early 1990s when there was no further need for research and development on the Harwell site. Decommissioning commenced in the 1990s.

Harwell is located in an area of outstanding natural beauty in Oxfordshire. The designated area managed and operated by Research Sites Restoration Limited (RSRL) forms part of the Harwell Oxford Campus, a major science and business centre employing around 4,000 people. The decommissioning programme will release land and buildings, making them available for the campus.

Figure 12-02 – Prioritisation logic

Key Phase	Focus Areas	NDA Priority Area		
		1	2	3
Interim End State (Key Phase 1)	Site licence compliance.	✓		
	Processing and repackaging solid ILW in B462 Waste Management Facility, B459 and B220.		✓	
	Recovery and encapsulation of ILW sludges in LETP.		✓	
	Construction of the Harwell ILW Store.			✓
	Decommissioning of B220, B459, B462 WEP, LETP, BEPO reactor and MTRs.			✓
	Remediation of specific areas of contaminated land.			✓
Site Closure (Key Phase 2)	Operation of groundwater remediation plant.		✓	
	Delicensing discrete areas.			✓
	Emptying the Vault and Harwell ILW Stores.			✓
	Decommissioning remaining B462 Waste Management Facility.			✓

This table shows the major activities for this site and how they relate to the NDA led National Prioritisation Working Group priority areas.

Priority Area 1

Non-discretionary work that is necessary to maintain legal compliance and prescribed and agreed levels of safety and security.

Priority Area 2

Operations activities.

Priority Area 3

Discretionary work is that which will allow achievement and acceleration of decommissioning and all other work.

Current site focus/priority indicates the priority that each focus area will have when funds are being allocated.

Work Completed in the Previous Year

The project activities shown below summarise the work completed on the Harwell site during the previous year.

Highlights of the decommissioning and operational progress made during 2010/11 are provided below.

B220

Forty Remote Handled Intermediate Level Waste (RHILW) cans processed within the facility as planned.

A number of laboratories were cleaned out in preparation for decommissioning.

The second of three low temperature hot water boilers was replaced during the year. The existing boilers are coming to the end of their working lives and the replacement of this boiler reduces the risk of boiler breakdown and reduces the building maintenance requirements.

B459

An agreement was reached with NDA to provide a route via B459 for repacking of radioactive sources recovered through the UK source recovery programme.

Significant safety case work has been carried out during the year to enable B459 to transition from a Category 1 Operational Facility to a Category 3 Care and Maintenance Facility.

BEPO & Hangar 10

The Hangar 10 (H10) complex, including the BEPO reactor, continues to be maintained under care and maintenance.

The old inlet and extract air ducts were opened to allow examination of the reactor's radiological characteristics.

The decommissioning and demolition of the Irradiation Facility in building H10.40 was completed during the year.

RSRL have taken ownership of building H10.3 and incorporated it into the safety management arrangements for the Hangar, following the departure of its previous tenants.

Harwell Balance of Site Structures

Decommissioning and demolition of redundant buildings continued including B401.4 (reactor test building) and B413 (active laundry). The floor slab of B393.1 (post irradiation examination facility) was

removed and the land remediated (see fig 12-02).

The Balance of Site Structures (BoSS) team continued to support an application to establish a new route for the processing of high volume low activity waste (HVLA) / Low Level Waste (LLW).

Work to decommission the trade waste drainage system continued. A contract for decommissioning of New Main Active Drain was placed and design work commenced.

Harwell Environmental Restoration

Both the groundwater remediation plant and the thermally enhanced vapour extraction process continued to remove solvents successfully.

Harwell Waste & Nuclear Material Management

Remote Handled Intermediate Level Waste RHILW can recovery from the tube stores and processing through the Head End Cell is in progress. RSRL exceeded its stretch target by processing more than 660 cans.

Contact Handled Intermediate Level Waste

The processing of Contact Handled Intermediate Level Waste (CHILW) also continued this year.

The six crates have been completed, and are being stored on site on an interim basis until the Geological Disposal Facility (GDF) is available.

Low Level Waste

The processing, packing and shipment of Low Level Waste to the national LLWR (Low Level Waste Repository) continued. A total of 10 ISO containers were processed and dispatched to the LLWR.

Liquid Effluent Treatment Plant

The Liquid Effluent Treatment Plant (LETP) team successfully converted a waste storage building into a dedicated waste processing facility and demolished 336.18E Pumphouse.

The team also continued to make progress on the following tasks:

- Treating effluent arising from facilities on site.
- Remobilisation and encapsulation of LLW sludges from HLA tanks.
- Processing and encapsulation of LLW 'WHESSOE' sludges.
- Processing and treatment of contaminated Carboys/Warboys.
- Characterisation and consignment of organic wastes.

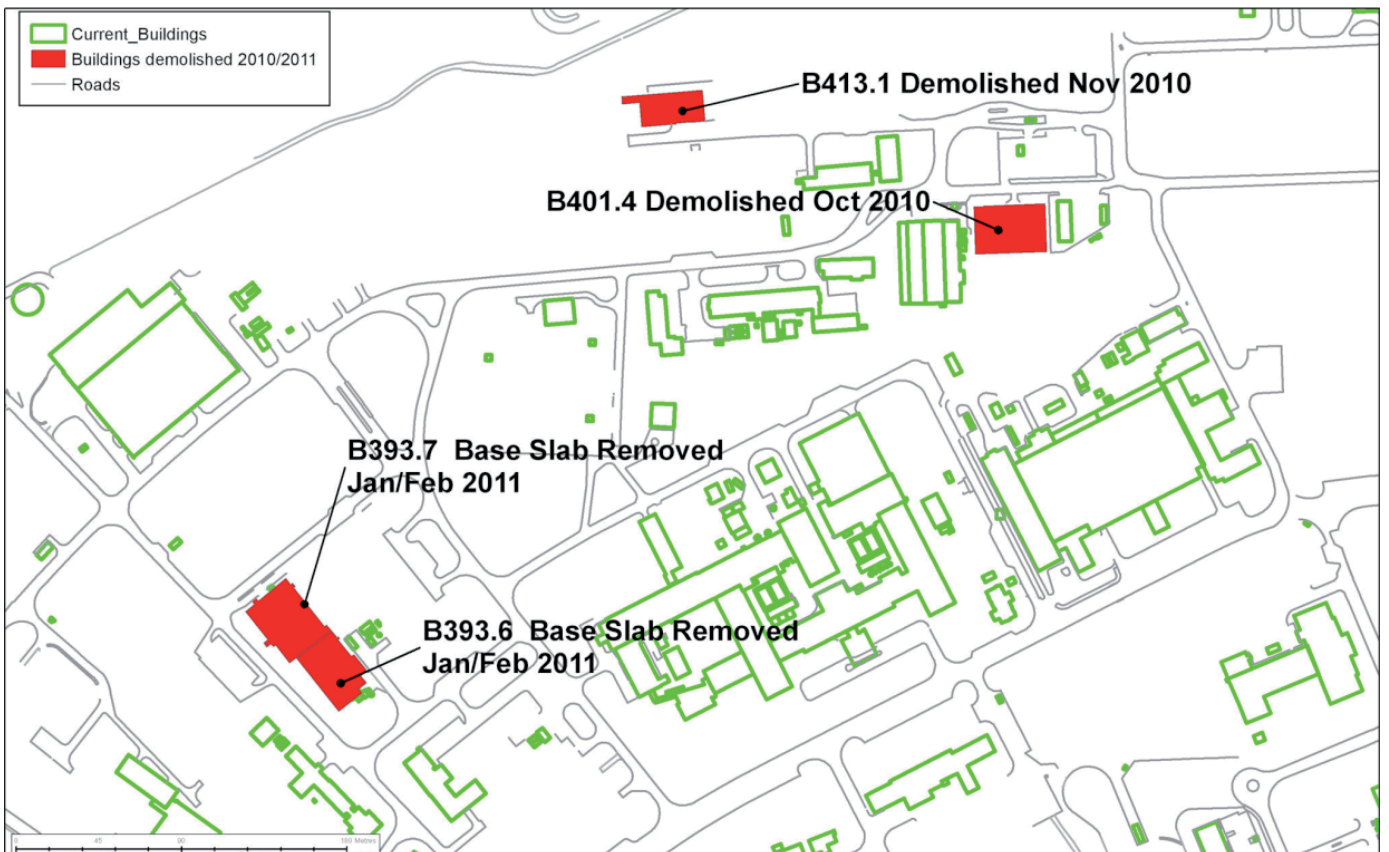
Material Testing Reactors

The Materials Test Reactors continue to be maintained under a care and maintenance schedule. Inspection and sampling activities were undertaken to ensure structural integrity of the reactors including an intrusive structural and radiological inspection of the Plant Rooms below the reactors.

Eastern Area

The Eastern Area of the site was released from security control after completion of the new Emergency and Police Building and the new Eastern Entrance. A delicensing case for the North Gate Area was submitted to the NII.

Figure 12-03 – Buildings Demolished in 2010/11



Lifetime Plan Overview



Site Summary Level



The work to deliver the decommissioning programme and achieve the site end-point is covered by two key phases:

- Interim End State
- Site Closure

The plan for the Harwell site is as follows:

Key Phase 1:

Achieve Interim End State

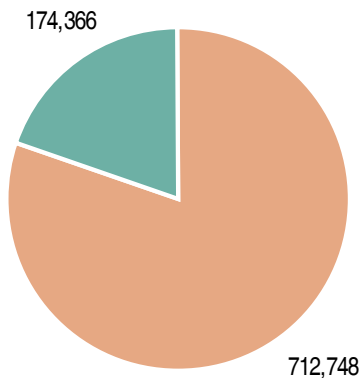
- Make radioactive waste passively safe and temporarily store it and/or transfer it off the site.
- Decommission redundant nuclear facilities.
- Remediate contaminated land and groundwater.
- Demolish redundant buildings.
- Delicense the site as areas are completed.
- Build ILW Store
- De-designate the bulk of the site

Key Phase 2:

Achieve Final End State

- Operate Vault Store and Harwell ILW Store until Geological Disposal Facility (GDF) is available.
- Transport waste from Vault Store and Harwell ILW Store to the GDF.
- Decommission the remaining B462 Waste Management Facility.
- Delicense the remaining site.
- De-designate the remainder of the site (NDA).

Figure 12-04 – Total cost distribution by key phase for Lifetime Plan (£k)



Key	■	Interim End State
	■	Site Closure

Detailed Volume Level

Detailed volumes for all projects contain the following documents:

Scope Statements

Schedules

Cost Estimate

Site Level Documents



1. Interim End State (2011 to 2031)

Waste Operations

Wastes managed at Harwell consist of legacy ILW from historic operations and new arisings from decommissioning activities.

Waste operations include retrieval and repackaging of remote-handled ILW stored in B462 Waste Management Facility, processing and repackaging of remote-handled ILW in B220 and contact-handled ILW in B462 Waste Management Facility, and immobilisation and encapsulation of LLW sludges stored at the LETP. Solid LLW is currently transported to the national LLW repository, and treated liquid waste is discharged to the River Thames.

In order to progress the waste operations some construction of new facilities is required. A Waste Encapsulation Plant (WEP) is being commissioned to immobilise ILW stored in the Vault Store. An additional ILW Storage facility will be constructed at an appropriate time to hold RHILW and CHILW produced in decommissioning activities and other B462 processes. A waste export facility will be constructed to support the transportation of the ILW to the GDF. An on-site waste disposal facility will be built for the disposal of high volume low activity waste unless an off-site route can be developed.

Decommissioning and Land Remediation

Harwell facilities will be decommissioned after their operations are complete and as levels of funding permit. In the interim, the facilities will be kept in care and maintenance to ensure they remain safe until decommissioned.

The LETP will be decommissioned first because of its outlying location and potential subsurface contamination. The LETP decommissioning will be followed by B220, B459 and BEPO/H10. Part of the B462 Waste Management Facility will be decommissioned after it completes its waste processing activities. Finally, the material test reactors, DIDO and PLUTO will be decommissioned. The Balance of Site Structures facilities will be sequenced into the overall decommissioning programme as funding permits.

Land including that under structures will be remediated to meet regulatory requirements by the removal of contaminated soil and other materials. Groundwater remediation of organic solvents released into the groundwater through historic disposal activities in the Western Storage Area (WSA) will continue until an agreement to terminate remediation is reached with the EA.

Delicensing

The NII will be requested to terminate its licence for areas of the site where decommissioning activities have been surveyed and verified complete. The majority of the site will be delicensed during this phase.

2. Site Closure (2032 to 2064)

Waste Operations

The Vault Store and Harwell ILW Store will be emptied and the waste transferred to the GDF beginning in 2040.

Decommissioning and Land Remediation

The remaining facilities in the B462 Waste Management Facility will be decommissioned and the associated land remediated during this phase.

Delicensing

The remainder of the site is expected to be delicensed during this phase.

Site End State

The site end state will be achieved incrementally on an area by area basis throughout both phases. This will allow land to be transferred to the Harwell Oxford Campus as soon as practicable.

Once the delicensing work is completed during Phase 2 the decommissioning programme for the Harwell site will have been delivered.

Key Phase 1 - Interim End State

In this key phase from 2011 to 2031, the focus is on making historic arisings of radioactive waste passively safe and/or transferring them off the site, and decommissioning redundant nuclear facilities.



Waste processing and repackaging operations

Waste Operations

ILW Operations

Remote handled ILW (RHILW) operations in B462 include the retrieval of historic waste from subsurface storage tubes using two purpose-built shielded retrieval machines. This waste along with RHILW from B220 is being processed in the Head End Cells (HEC). After remote sorting and packaging the waste is transferred from the HEC to the Vault Store. Upon commissioning of the Waste Encapsulation Plant, the waste will be retrieved from the Vault Store encapsulated in the plant and returned to the Vault Store for storage until it is shipped to the GDF. An additional ILW storage facility will be

constructed to hold waste produced during reactor decommissioning and other B462 processes.

B220 is processing radium-contaminated wastes stored in sealed containers. The waste is removed from the containers, repackaged, and encapsulated before returning the waste to B462 for final processing and storage.

Contact-handled ILW (CHILW) operations in B462 involve the receipt of new arisings, processing and decontamination activities and the storage of various historic wastes, including drummed CHILW and Concrete Lined Drums (CLDs) containing Plutonium Contaminated Material (PCM). Operations will include the processing of CHILW drums and CLDs into a passively safe form and the transfer of this waste to the GDF. The CHILW stored in B220, will be processed in B462.

LLW Operations

LLW is temporarily stored in the B462 Waste Management Facility, and if necessary repackaged into drums suitable for disposal. It is then transported to the national LLW repository, or for supercompaction on another site before disposal.

The Harwell programme includes construction of an on-site waste facility to dispose materials with very low levels of radioactivity. However, efforts are in progress to identify an off-site route for these materials. The on-site facility will not be constructed if an off-site route is identified.

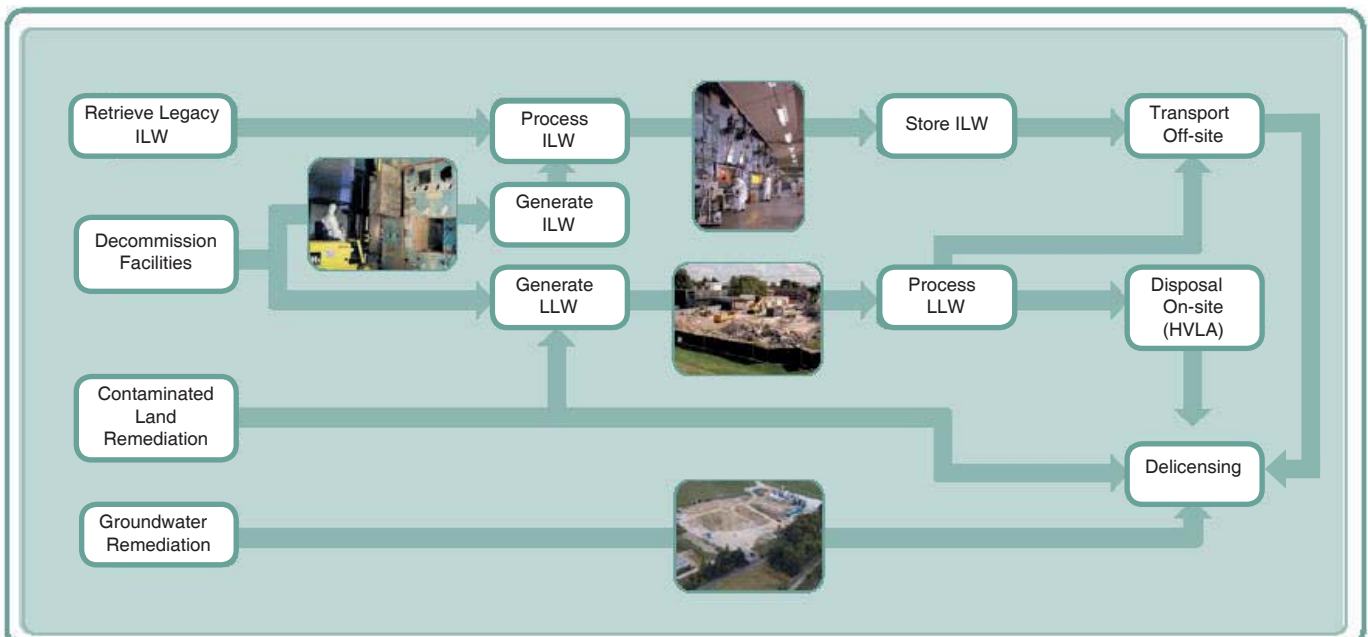
Operations at the LETP include the treatment of low-level active liquid waste prior to discharge to the River Thames. Historic sludges are being encapsulated in a purpose-built plant for subsequent disposal as solid LLW. Active organic liquids are filtered and dispatched off-site for incineration.

A replacement effluent treatment plant will be installed in B462 so that the LETP can be shut down and decommissioned.

Non-radioactive waste disposal (hazardous and non-hazardous waste)

Non-radioactive waste is processed and disposed of off-site.

Figure 12-05 – Interim End State scope of work by type





Post Operational Clean Out.



Radiation Monitoring Surveys.

Decommissioning

Care and Maintenance

Facilities at Harwell awaiting decommissioning are in a care and maintenance programme to ensure they remain safe until decommissioning. Routine maintenance is conducted to maintain structural integrity. Facilities in care and maintenance include the reactors (DIDO, PLUTO, and BEPO), B459, and sections of B220 as well as multiple minor facilities.

Decommissioning

Harwell facilities will be decommissioned after their operations are complete and as levels of funding permit.

A number of significant decommissioning activities have occurred since the start of decommissioning in the 1990s. The LETP is the next scheduled significant decommissioning project due to its outlying location and potential subsurface contamination. The LETP decommissioning will be followed by B220, B459 and BEPO/H10. Part of the B462 Complex will be decommissioned after it completes its waste processing activities. Finally, the material test reactors, DIDO and PLUTO will be decommissioned. The Balance of Site Structures will be sequenced into the overall decommissioning programme as funding permits.

Contaminated Land and Groundwater Remediation

Remediation activities will be carried out on the following:

- Any land or underground structures associated with facilities not meeting the release criteria for delicensing including the LETP underground structures.
- Known contaminated land areas consisting of B521 Mound and Sludge Beds, and a number of small disposal pits located in the Meashill Plantation.
- Two Meashill Trenches located near B462.

A groundwater treatment plant will operate at the WSA to treat the chemically contaminated groundwater. Unsaturated zone solvent recovery will be conducted over a number of remediated WSA disposal pits to prevent solvent from entering the groundwater. Treatment will continue until its termination is agreed with the EA.

Delicensing

As each area of the site becomes available on completion of decommissioning and land remediation activities, a Delicensing Case will be prepared and submitted to the NII.

This will be achieved by:

Surveys

Surveys will be carried out to verify the

adequacy of decommissioning/land remediation work and demonstrate the area can be closed out. The surveys are also carried out in buildings, for delicensing purposes, and include carrying out minor remediation works when necessary.

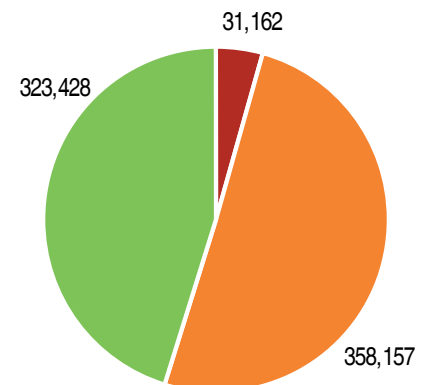
Close-out

This involves assessing the results from the above surveys and entering the data and associated reports on the IMAGES (a Geographical Information System) database, preparing Land Condition Reports to record the status of the land and preparing Delicensing Cases. Delicensing cases will then be submitted to the NII for approval.

Handover

Following approval of a Delicensing Case by the NII, changes to the licenced site boundary are marked and RSRL will request that the land area is de-designated by the NDA to allow use of the land as a part of the Harwell Oxford Campus.

Figure 12-06 – Key phase cost distribution by category (£k)



Key	Category	Code
■	New Construction Projects	(12.11)
■	Decommissioning & Termination	(12.13)
■	Waste & Nuclear Materials Management	(12.14)

Key Phase 2 - Site Closure

In the second key phase from 2032 to 2064, the remainder of the site will be restored to make clean land and buildings available for development.

Waste Operations

An Export Facility will be constructed to support waste transportation activities. ILW shipments to the GDF will then commence.

The Vault Store and Harwell ILW Store, both containing packaged ILW, will be emptied during this phase, and the waste transferred to the GDF at a frequency that will be determined as a part of a national programme.

Decommissioning

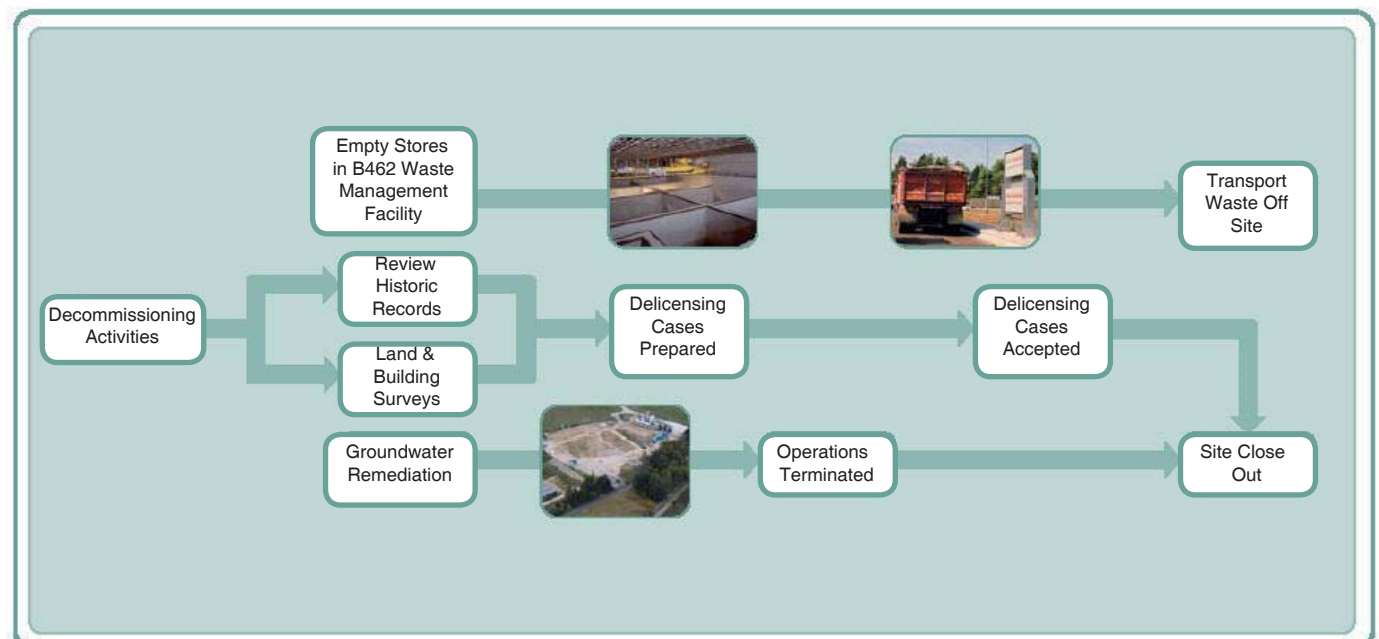
Final Decommissioning

Once the Vault Store and the Harwell ILW Store have been emptied, these and the Export Facility will be decontaminated and demolished, followed by the associated land being remediated.

Final decommissioning of the B462 Waste Management Facility is expected to be completed in 2063.



Figure 12-07 – Site Closure scope of work by type





B424 Prior to demolition



Remediated land where B424 stood

Land Remediation

The land remediation work will remove underground structures, contaminated soil and materials as necessary to meet delicensing criteria and other good practice standards. Clean soils and materials will be recycled for re-use in landscaping the site. The site will be landscaped as a generally flat site, blended to existing land levels, with a grassed surface.

Delicensing

The last area, B462 and adjacent land, is expected to be delicensed by the NII prior to completion of the programme in 2064. This will be achieved by:

Surveys

Surveys will be carried out to verify the adequacy of the decommissioning/land remediation work in B462 area to demonstrate the area can be delicensed.

Close-out

Close-out involves preparing Land Condition Reports to record the status of the land and preparing the Delicensing Case. The Delicensing Case for B462 area will then be submitted to the NII for approval.

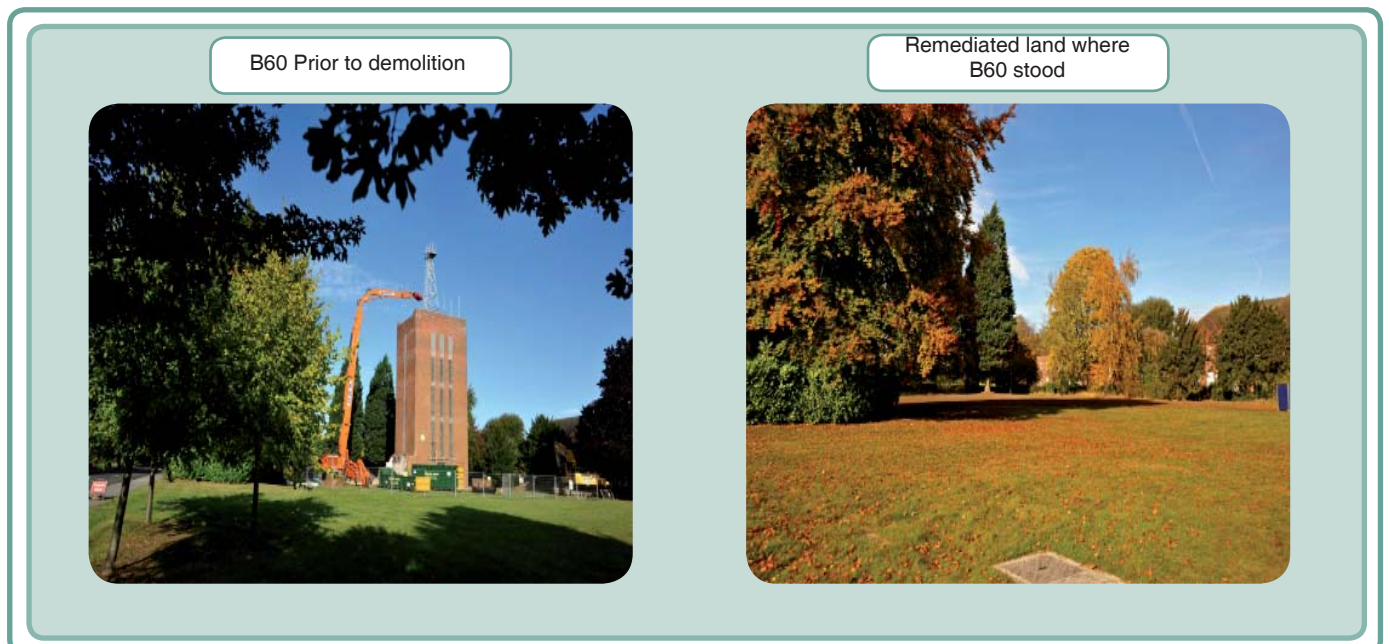
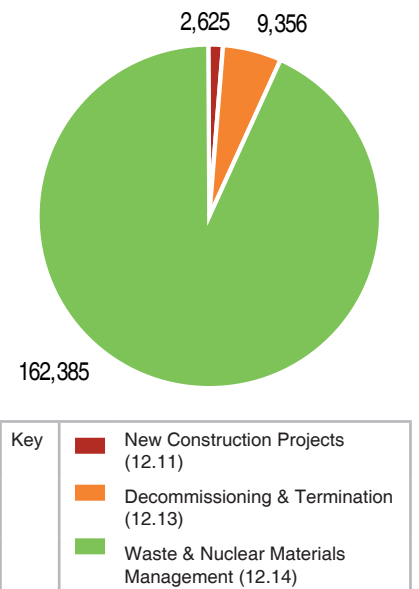
Site End State

To reach the Site End State the following activities will be required:

Approval of a Delicensing Case by the NII, removal of the existing licenced site boundary markers and termination of the Nuclear Site Licence. RSRL will request that this last area of land is de-designated by the NDA.

The NDA will remove its designation that allows the final end state to be achieved and places the Harwell site in a condition to allow all of the land to be part of the Harwell Oxford Campus.

Figure 12-08 – Key phase cost distribution by category (£k)



New Construction Projects (12.11)

The New Construction Projects primarily include the provision of facilities to retrieve, encapsulate and subsequently transport intermediate-level waste off the site.



Construction of the WEP

The following facility will be constructed to support ILW processing:

Waste Encapsulation Plant (WEP)

The WEP will consist of a plant for encapsulating the ILW to be stored in the Vault Store, and also a facility for the monitoring and inspection of the drums of waste throughout their period of storage. The work remaining involves commissioning of the WEP.

The following facilities will be constructed to support ILW storage:

Harwell ILW Store

A store will be constructed to accommodate ILW from reactor decommissioning and the processing of legacy contact-handled ILW. The reactor ILW waste will be packaged in shielded containers and the CHILW will be stored in drums. These drums will be overpacked and grouted into final disposal containers on export to the GDF. The ILW Store work will involve detailed design followed by the construction and commissioning of the store.

Export Facility

An Export Facility will be constructed so that the ILW drums retrieved from the Vault Store can be placed in standard waste transport containers for disposal to the GDF.

Other facilities and projects are required in order to complete the delicensing of the Harwell site. These are:

High Volume Low Activity (HVLA) Waste Disposal Facility

Access to a HVLA facility is needed to support remediation of large land areas and decommissioning of mildly contaminated facilities. The decommissioning programme includes construction of an on-site high volume low activity waste facility to dispose materials with very low levels of radioactivity. However, efforts are underway to identify an off-site route for these materials. The on-site facility will not be constructed if an off-site route is identified.

Infrastructure Projects

A number of site infrastructure projects are necessary to fulfil safety, legislative and security requirements. Also to facilitate site delicensing it will be necessary, at different times, to relocate fence and change road access arrangements to appropriate security standards, and rationalise accommodation for remaining staff.



Figure 12-09 – New Construction Projects budgeted cost of work scheduled (BCWS) profile curve

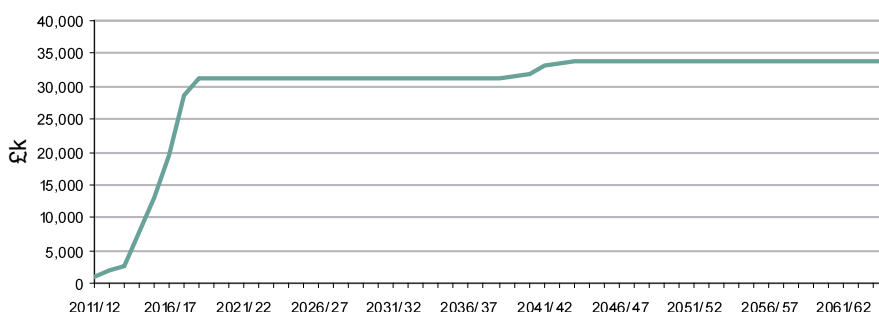


Figure 12-10 – Staffing profile curve against time for New Construction Projects

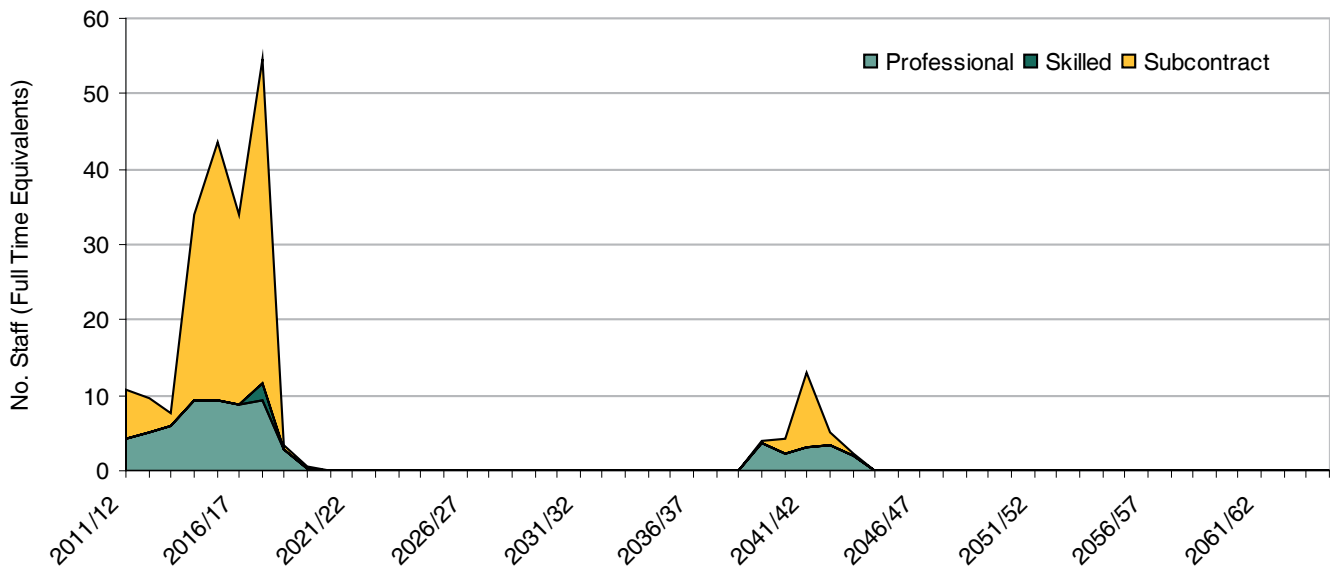


Figure 12-11 – New Construction Projects summary of costs

Type	FYs 2011 - 2015					Subtotal years 1-5 (£k)	Subtotal years 6-10 (£k)	Lifecycle Balance years 11+ (£k)	Total To Go Cost (£k)
	Year 1 (£k)	Year 2 (£k)	Year 3 (£k)	Year 4 (£k)	Year 5 (£k)				
Waste & Materials Management (12.11.12)	676	516	557	5,116	5,167	12,033	18,053	2,625	32,712
Infrastructure (12.11.13)	246	414	68	90	90	908	167	0	1,075
Subtotal	922	931	626	5,206	5,257	12,942	18,220	2,625	33,787
Escalation Total	922	960	665	5,705	5,940	14,192	21,742	6,551	42,485
Discounting Total	922	911	599	4,877	4,819	12,128	16,068	1,369	29,564

* Values subject to rounding discrepancies

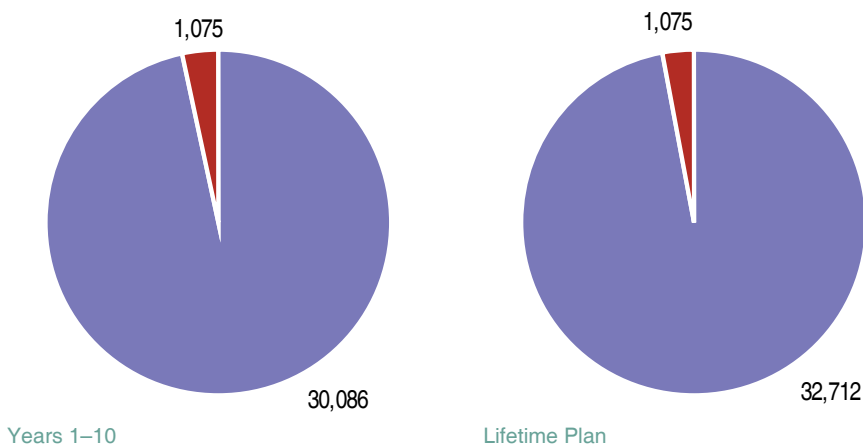


Figure 12-12 – New Construction Projects cost distribution by type for years 1 to 10 and Lifetime Plan (£k)

Key	Color
Waste & Materials Management (12.11.12)	Blue
Infrastructure (12.11.13)	Red

Decommissioning & Termination (12.13)

This category focuses on decommissioning minor facilities, three reactors and waste management facilities, remediating contaminated land and groundwater, and progressively delicensing the site.

Reactors

BEPO, located in Hangar 10, is in care and maintenance. Space has been created, by demolishing the Irradiation Facility housed in H10, for the installation of waste handling equipment, which will be used to demolish the Storage Block. It is intended that this same equipment can then be used to make an engineered entry through the BEPO biological shield to provide access to the reactor core and subsequent demolition. Demolition of the hangar structure and excavation of underground services will follow the internal clearance of the hangar.

Decommissioning of the MTRs DIDO and PLUTO will be carried out in series, to benefit from the common use of facilities and equipment. Both reactors will require refurbishment or replacement of internal features such as the cranes and flasks. The sequence of activities will begin with the removal of the long-term stored reactor rigs and other neutron-irradiated components. The reactor structures will be dismantled and the waste segregated and packed in shielded containers. Excavation of structures and services below ground level will be followed by remediation of the land areas.

Waste Management Facilities

B220 has been split into five discrete zones aligned to the past use and the future planned sequence of decommissioning. Decommissioning involves the removal of radioactive materials, equipment, residual contamination and the ventilation system in each zone, followed by the progressive demolition of the building. Thereafter the base slab and underground services and structures will be removed. The area will be backfilled with clean materials.

B459 will be decommissioned by removing components from the cell line, decontaminating the cells, removing the ventilation system and demolishing the building. The base slab will be excavated and any subsurface contamination will be removed.

The LETP will be decommissioned by removing equipment followed by decontamination and demolition of the buildings. Contaminated soil will be removed after demolition. The River Thames discharge pipeline will be decontaminated and removed. The site drains system will be decontaminated and grouted or removed dependent on the level of radioactivity present.

As RHILW and CHILW operations progress most of the buildings in B462 Waste Management Facility will become redundant and will be decommissioned and demolished when they become available. The only buildings remaining on the site after 2032 will be the Vault Store and Head End Cells (HEC), WEP, Harwell ILW Store and a support building. Decommissioning of these buildings and the Export Facility will commence once the ILW has been disposed of to the Geological Disposal Facility.

Other Nuclear Facilities

The Balance of Site Structures on the site (including their underground services and structures) will be decommissioned and demolished as funding permits. Demolition may be brought forward if building integrity becomes compromised.

This work involves stripping out redundant services and removing hazardous material,

including low levels of radioactivity and contaminated equipment, followed by demolition and any associated land remediation.

Contaminated Land and Groundwater Remediation and Delicensing

The Western Storage Area (WSA) clean up will continue with removal of solvent from the unsaturated zone. This activity prevents solvent from reaching the groundwater. Groundwater recovery and cleanup will continue until about 2025 when regulator concurrence is expected that further treatment is not necessary.

The B521 Mound and Sludge Beds, Meashill Plantation (made up of around 40 small disposal pits) and the Meashill trenches contain various waste contaminated with asbestos fibres and chemical and radioactive contaminants, as well as building debris, discrete radioactive items and possibly munitions. This material will be segregated then disposed of as HVLA, LLW, hazardous or non-hazardous waste as appropriate. Contaminated soil will be disposed of to landfill and clean material will be recycled for re-use in landscaping the area.

The site will be progressively delicensed.

Figure 12-13 – Decommissioning & Termination budgeted cost of work scheduled (BCWS) profile curve

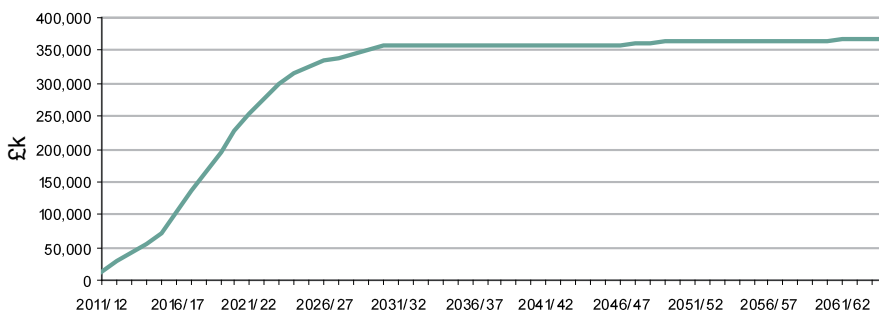


Figure 12-14 – Staffing profile curve against time for Decommissioning & Termination activities

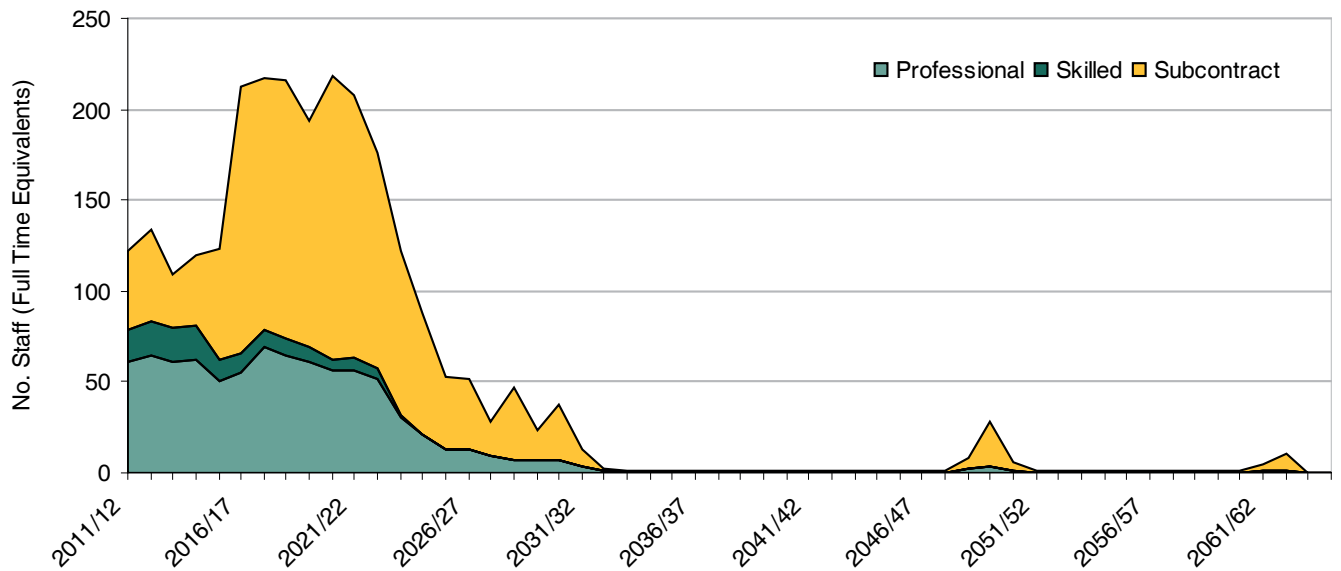


Figure 12-15 – Decommissioning & Termination summary of costs

Type	FYs 2011 - 2015					Subtotal years 1-5 (£k)	Subtotal years 6-10 (£k)	Lifecycle Balance years 11+ (£k)	Total To Go Cost (£k)
	Year 1 (£k)	Year 2 (£k)	Year 3 (£k)	Year 4 (£k)	Year 5 (£k)				
Surveillance & Maintenance (12.13.31)	2,020	1,680	1,684	1,681	1,684	8,750	4,389	6,908	20,046
Care & Maintenance (12.13.33)	2,599	2,692	2,662	2,626	2,515	13,095	6,838	2,339	22,272
Final Decommissioning (12.13.34)	5,742	10,628	7,643	9,088	8,130	41,231	125,288	109,942	276,461
Groundwater Remediation (12.13.35)	877	412	412	412	412	2,524	2,529	4,569	9,622
Contaminated Land Remediation (12.13.36)	540	416	218	219	1,323	2,716	14,072	13,195	29,983
Site Close-Out (12.13.37)	259	580	442	449	442	2,171	2,448	4,511	9,131
Subtotal	12,037	16,409	13,060	14,476	14,506	70,487	155,563	141,464	367,514
Escalation Total	12,037	16,918	13,882	15,864	16,390	75,091	192,427	229,310	496,828
Discounting Total	12,037	16,056	12,504	13,561	13,297	67,454	133,840	103,808	305,101

* Values subject to rounding discrepancies

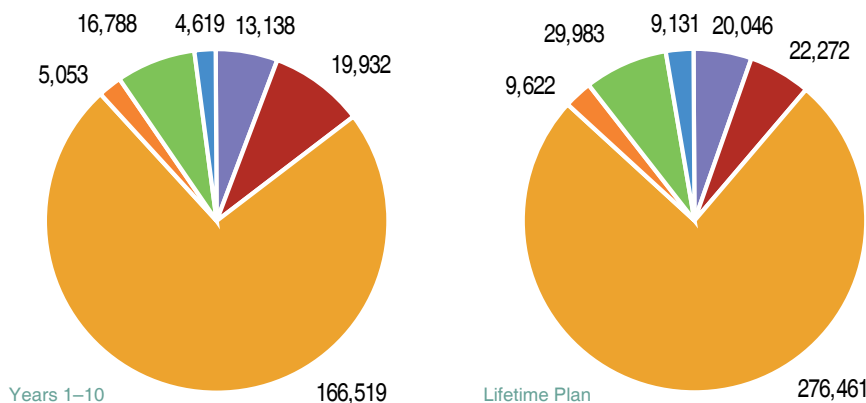
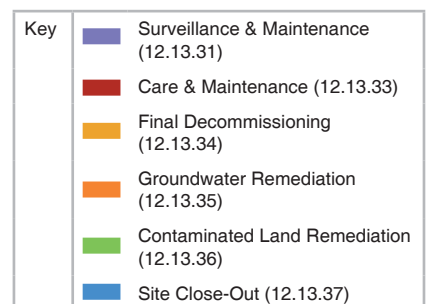


Figure 12-16 – Decommissioning & Termination cost distribution by type for years 1 to 10 and Lifetime Plan (£k)



Waste & Nuclear Materials Management (12.14)

This category includes the retrieval, size reduction, processing, storage and onward transport of waste.

Waste Operations

ILW Operations

Remote handled ILW (RHILW) operations in B462 include the retrieval of historic waste from subsurface storage tubes using two purpose-built shielded retrieval machines. This waste along with RHILW from B220 is being processed in the Head End Cells (HEC). After remote sorting and packaging the waste is transferred from the HEC to the Vault Store. Upon commissioning of the Waste Encapsulation Plant, the waste will be retrieved from the Vault Store encapsulated in the plant and returned to the Vault Store for storage until it is shipped to a geological disposal facility (GDF). An additional ILW storage facility will be constructed to hold waste produced in decommissioning activities and other B462 processes.

An operational cell is being maintained in B459 to process radioactive sources recovered from within the UK. These sources are repackaged and sent to B462 for processing.

The focus of RHILW operations in B220 is the processing of radium-contaminated wastes stored in sealed containers. The waste is removed from the containers, repackaged, and encapsulated before returning the waste to B462 for final processing and storage.

Contact-handled (CHILW) ILW operations in B462 involve the receipt of new arisings, processing and decontamination activities and the storage of various historic wastes, including drummed CHILW and Concrete Lined Drums (CLDs) containing Plutonium Contaminated Material (PCM). Operations will include the processing of CHILW drums

and CLDs into a passively safe form and the transfer of this waste to the GDF. The CHILW stored in B220, will be processed in B462.

LLW Operations

LLW is temporarily stored in the B462 Waste Management Facility, and if necessary repackaged into drums suitable for disposal. It is then transported to the national LLW repository, or for supercompaction on another site before disposal.

The decommissioning programme includes an on-site high volume low activity waste facility to dispose materials with very low levels of radioactivity. However, efforts are in progress to identify an off-site route for these materials.

Operations at the LETP include the treatment of low-level active liquid waste prior to discharge to the River Thames. Historic sludges are being encapsulated in a purpose-built plant for subsequent disposal as solid LLW. Active organic liquids are filtered and dispatched off-site for incineration.

A replacement effluent treatment plant will be designed and installed in B462 so that the LETP can be shut down and decommissioned.

Non-radioactive waste disposal

(hazardous and non-hazardous waste)
Non-radioactive waste is processed and disposed of off-site.

Figure 12-17 – W&NMM budgeted cost of work scheduled (BCWS) profile curve

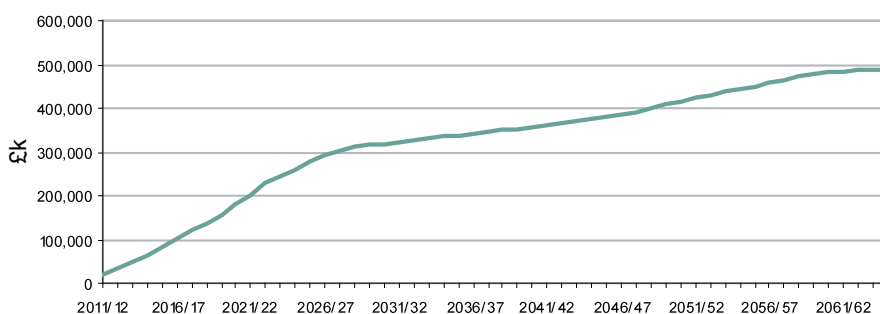


Figure 12-18 – Staffing profile curve against time for W&NMM activities

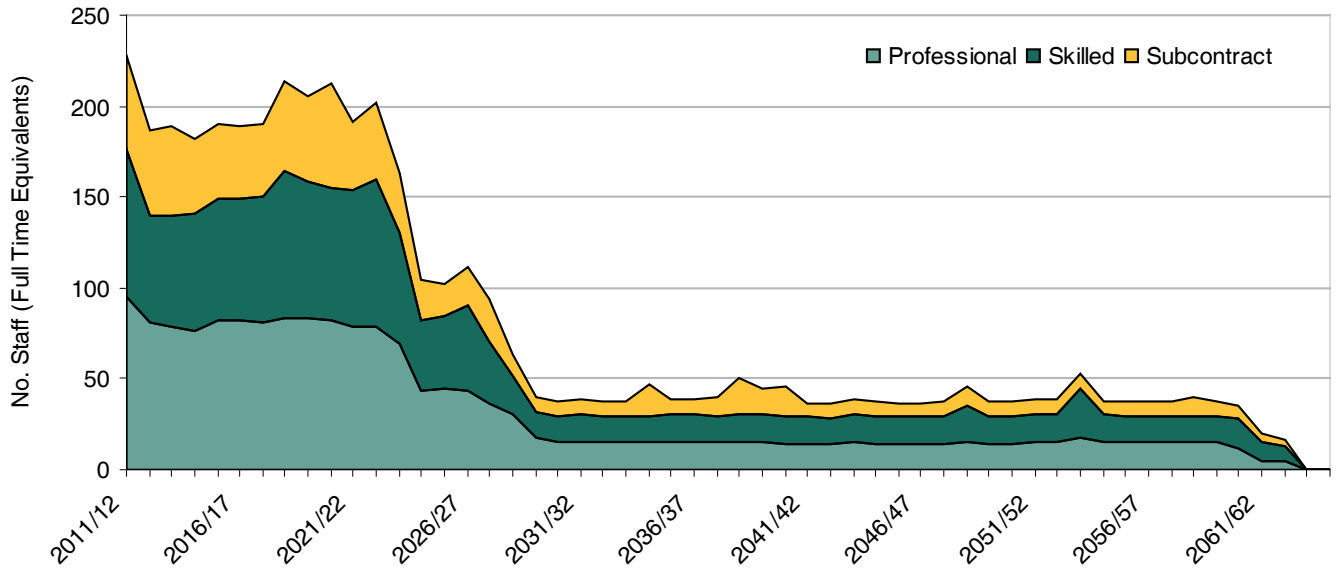


Figure 12-19 – W&NMM summary of costs

Type	FYs 2011 - 2015					Subtotal years 1-5 (£k)	Subtotal years 6-10 (£k)	Lifecycle Balance years 11+ (£k)	Total To Go Cost (£k)
	Year 1 (£k)	Year 2 (£k)	Year 3 (£k)	Year 4 (£k)	Year 5 (£k)				
ILW Operations (12.14.41)	13,742	12,766	15,153	13,524	14,217	69,403	78,028	239,826	387,258
LLW Operations (12.14.43)	4,608	2,283	1,304	1,268	1,606	11,070	13,801	57,503	82,373
Hazardous Operations (12.14.45)	13	0	37	1	8	59	20	286	365
Non-Hazardous Operations (12.14.46)	174	335	38	218	767	1,531	6,148	8,138	15,817
Subtotal	18,538	15,384	16,532	15,011	16,598	82,063	97,997	305,753	485,813
Escalation Total	18,538	15,861	17,573	16,451	18,754	87,176	121,670	735,145	943,991
Discounting Total	18,538	15,053	15,828	14,062	15,214	78,695	84,092	180,944	343,731

* Values subject to rounding discrepancies

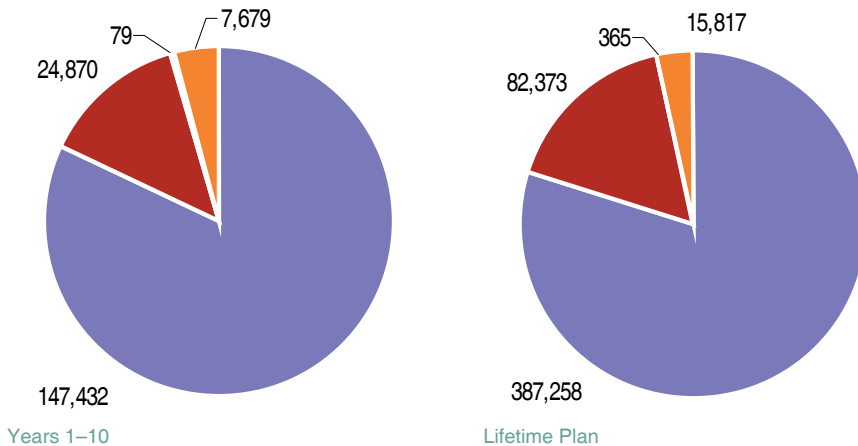


Figure 12-20 – W&NMM cost distribution by type for years 1 to 10 and Lifetime Plan (£k)

Key	Color
ILW Operations (12.14.41)	Blue
LLW Operations (12.14.43)	Red
Hazardous Operations (12.14.45)	Yellow
Non-Hazardous Operations (12.14.46)	Orange

Summary Milestone Schedule

RSRL staff are committed to completing the activities outlined in this summary in a timely, safe and cost-effective manner.

Key milestones

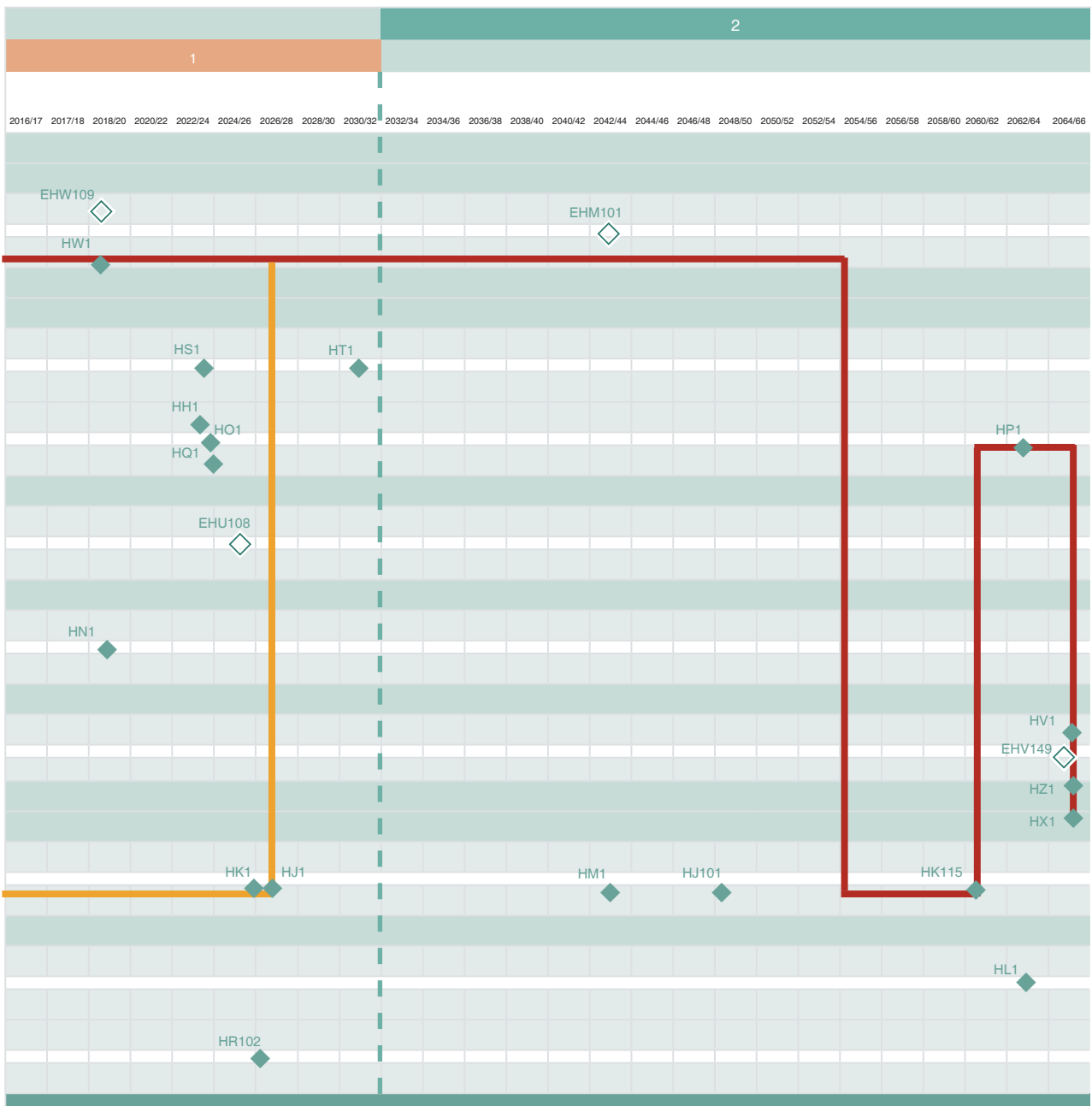
Figure 12-21 – Lifetime Plan milestone summary schedule

	Date	Description
◇	Regulatory	
EHW109	July 2018	NII Licence Instrument granted for Harwell ILW Store
EHU108	Jan 2026	WSA Waste Management Licence transferred
EHM101	Nov 2043	NII Licence Instrument granted for ILW Export Facility
EHV149	Jul 2064	B462 Area Delicensing Case accepted by NII
◆	Other	
HI1	Mar 2012	B220 ILW Operations complete
HA1	Mar 2013	WSA Land remediated
HD2	Mar 2013	B459 Extended ILW Operations complete
HF1	Jun 2013	Site Active Drains decommissioned
HW102	Mar 2014	Contract placed for Harwell ILW Store
HE1	May 2014	B462 WEP Operational
HB1	Oct 2014	LETP LLW Operations complete
HG1	May 2015	LETP Buildings and Tanks decommissioned
HR101	Sep 2015	HVLA Facility operational
HW1	Jul 2018	Harwell ILW Store operational
HN1	Nov 2018	LETP Land Remediation complete
HH1	Mar 2023	BoSS decommissioning complete
HO1	Jun 2023	B459 decommissioned
HS1	Nov 2023	BEPO/H10 decommissioning complete
HQ1	Mar 2024	B220 decommissioned
HR102	May 2026	All HVLA transferred to HVLA Waste Management option
HK1	Sep 2026	B462 CHILW operations complete
HJ1	Dec 2026	B462 RHILW Processing complete
HT1	Aug 2031	MTRs decommissioned
HM1	Nov 2043	Export Facility operational
HJ101	Aug 2048	RHILW transferred off-site
HK115	Sep 2060	Harwell ILW Store emptied
HL1	Mar 2063	B462 LLW Operations complete
HP1	Mar 2063	B462 Waste Management Facility decommissioned
HV1	Oct 2064	Site Clearance, Delicensing & Close Out complete
HZ1	Oct 2064	Harwell Site Closed Out
HX1	Oct 2064	RSRL Sites Closed Out



- Key**
- Critical Path
 - Other Paths of Concern
 - ◊ Regulatory Milestone
 - ◆ Other Milestone

Milestone schedule – continued



Lifetime Plan Costs

RSRL is committed to delivering value for money in all its activities; all proposed expenditure is being reviewed using appropriate costing methods.

Figure 12-22 – Summary of costs – present day, escalated and discounted values

Category	2005/09 cost (£k)	Prior years cost to date 2009/11 (£k)	FYs 2011 - 2015				
			Year 1 (£k)	Year 2 (£k)	Year 3 (£k)	Year 4 (£k)	Year 5 (£k)
New Construction Projects (12.11)	24,615	181	922	931	626	5,206	5,257
Decommissioning & Termination (12.13)	37,846	11,844	12,037	16,409	13,060	14,476	14,506
W&NMM (12.14)	88,886	40,842	18,538	15,384	16,532	15,011	16,598
Subtotal	151,347	52,867	31,496	32,724	30,217	34,693	36,361
Escalation Total			31,496	33,738	32,120	38,020	41,084
Discounting Total			31,496	32,019	28,930	32,500	33,330

* Values subject to rounding discrepancies

The pricing of the work has been estimated using an appropriate costing method, which is set out in supporting Basis of Estimate documents. The cost of items and services provided by suppliers and subcontractors has been determined from existing contracts where possible and are based on experience of similar contracts. Such procurements are carried out in accordance with RSRL's Procurement Policy.

The cost of work undertaken by RSRL staff and contractors was derived from estimates of the time to undertake the work and the rate for the person undertaking the work. The resources determined the cost estimates and an appropriate level of uncertainty and risk was applied to the costs to determine the contingency which takes account of a Monte-Carlo type analysis. The escalation and discounting of costs was achieved by the application of NDA specified index factors.

Figure 12-23 – Years 1 to 5 category cost distribution (£k)

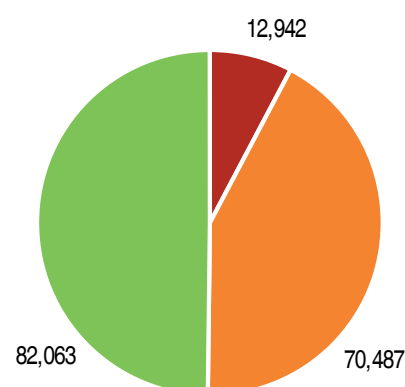


Figure 12-24 – Lifetime Plan Costs budgeted cost of work scheduled (BCWS) profile curve

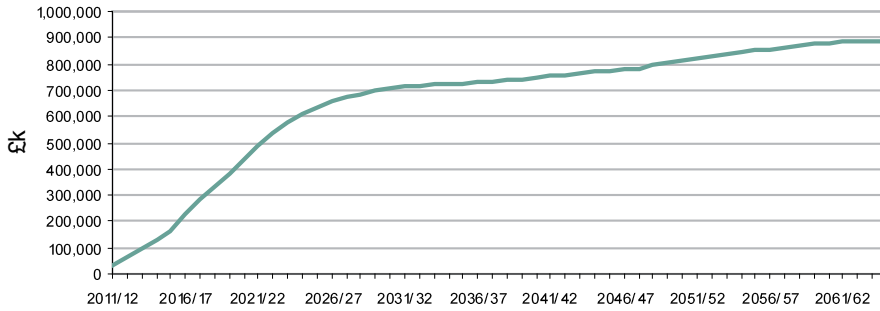


Figure 12-22 – Summary of costs – present day, escalated and discounted values – continued

Subtotal years 1-5 (£k)	FYs 2016 - 2020					Subtotal years 6-10 (£k)	Lifecycle Balance years 11+ (£k)	Total To Go Cost (£k)
	Year 6 (£k)	Year 7 (£k)	Year 8 (£k)	Year 9 (£k)	Year 10 (£k)			
12,942	6,525	9,203	2,446	41	4	18,220	2,625	33,787
70,487	34,085	33,057	29,241	27,356	31,823	155,563	141,464	367,514
82,063	19,818	18,941	18,163	18,178	22,898	97,997	305,753	485,813
165,491	60,428	61,201	49,850	45,575	54,725	271,780	449,842	887,114
176,459	70,394	73,504	61,728	58,183	72,031	335,839	971,006	1,483,304
158,276	54,198	53,710	42,807	38,293	44,992	234,000	286,121	678,397

Figure 12-25 – Years 6 to 10 category cost distribution (£k)

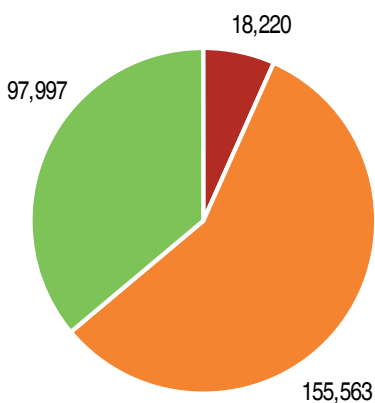
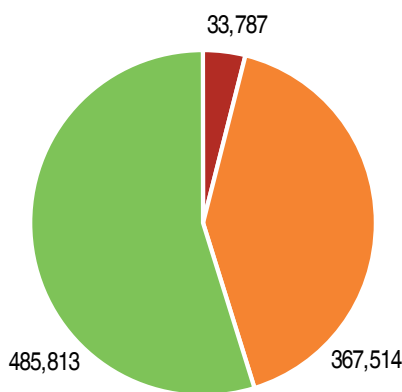


Figure 12-26 – Lifecycle category cost distribution (£k)



Key	
■	New Construction Projects (12.11)
■	Decommissioning & Termination (12.13)
■	Waste & Nuclear Materials Management (12.14)

Reconciliation of Costs

The overall impact of the changes that have been made to the Lifetime Plan since Lifetime Plan Baseline March 2010 Issue 2 is shown below:

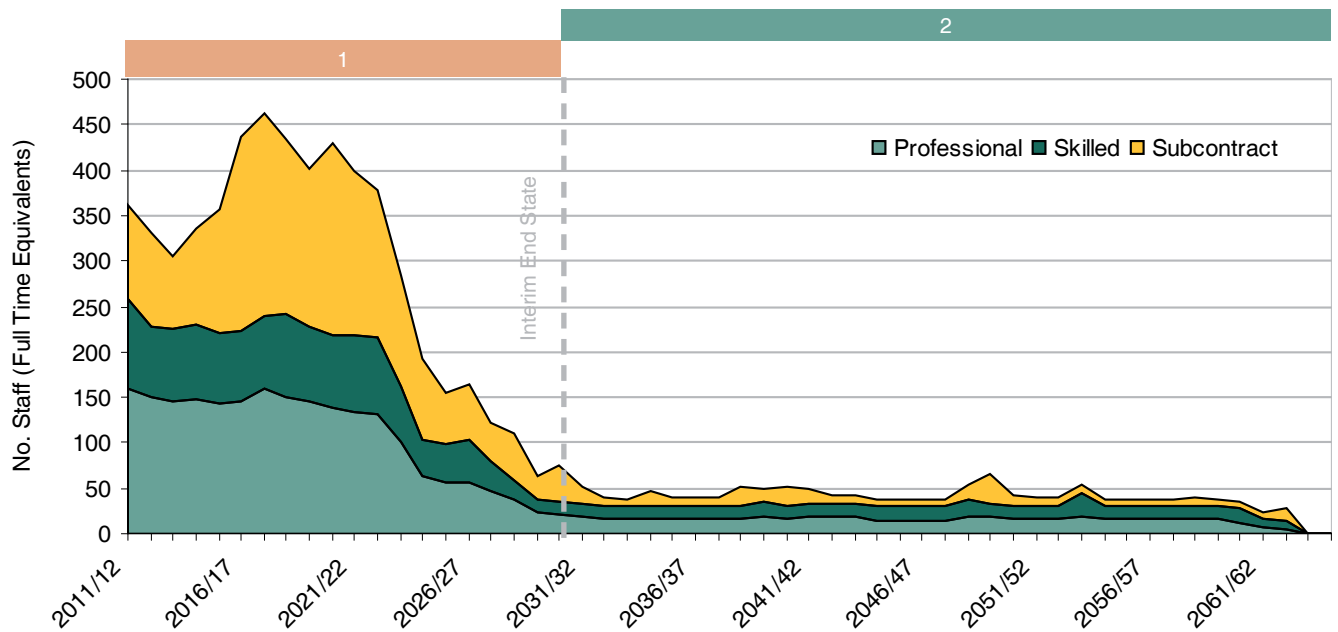
Figure 12-27 – Reconciliation of costs

Category	Lifetime Plan Baseline March 2011 (£k)	Lifetime Plan Baseline March 2010 (£k)	Variance (£k)	Description
New Construction Projects (12.11)	33,787	26,774	7,013	<ul style="list-style-type: none"> Revision of estimate for ILW Store (+£6,500)
Decommissioning & Termination (12.13)	367,514	330,711	36,802	<ul style="list-style-type: none"> Revision of estimate for B459 (+£400k) Decommissioning of OMAD (+£7,500k) LLWR rate increase for LETP Building decommissioning (+£900k) Re-estimate of BoSS Management cost (-£600k) Re-estimate of B220 maintenance costs as a result of extended C&M activities (+£4,500k) Re-estimate of B220 decommissioning and change in duration of decommissioning for B220 (+£23,000) Re-estimate of Groundwater Plant operations (-£1,400k) LLWR rate increase for BoSS Building decommissioning (+£100k)
Waste & Nuclear Materials Management (12.14)	485,813	460,961	24,852	<ul style="list-style-type: none"> Processing of beta/gamma Concrete Lined Drums (+3,400k) Increase to B462 programme duration as a result of deferral of 3rd shift in B462 (+£13,000) Addition of B418 Legacy waste (+£200k) Use of in-house resources for LETP Operations (-£300k) Re-estimate of RETP project (+£1,000k) Deferral of tube store decommissioning (+£200k) Re-estimate of B220 decommissioning as a result of increases in waste disposal charges (+£3,900k) Change in duration of C&M for B220 (-£2,300) LLWR rate increase for B462 (+£6,400k) Review of B220 ILW Operations to apply contingency to cover increased project duration as a result of processing additional radium cans (+£800k) Review of Technical Service Support requirements (-£300k) LLWR rate increase for reactors (+£600k) Review of B462 Soft Services and utility costs (-£1,900k)

Staffing Curve

The staffing levels required to resource the New Construction Projects, Decommissioning & Termination and Waste & Nuclear Materials Management categories are shown in the staffing curve below.

Figure 12-28 – Staffing profile curve against time and key phases



Staffing Profile

The staffing levels remain relatively constant until completion of the waste recovery activities. The levels then decline throughout the completion of decommissioning to meet the interim end state. There is a long period of ILW storage and shipment which requires minimal staff.

Major Assumptions

The decommissioning programme is planned on the basis of certain assumptions. The principal assumptions associated with the programme are outlined below.

Figure 12-29 – Major assumptions by category

Category	Assumptions	Justification
Decommissioning & Termination (12.13)		
	The end state of the property is acceptable for its incorporation into the Harwell Oxford Campus. This is defined as termination of the NII licence with appropriate EA authorisations for the High Volume Low Activity Waste Facility and Western Storage Area.	The end state for the site is consistent with the NDA strategy.
	The extent of contaminated land on-site is based on historic records and characterisation data.	Historic records and characterisation are sufficient to estimate the cost of remediation when combined with appropriate risk and contingency assumptions.
	The EA will consent to termination of the WSA Groundwater Containment Plant operations in 2025 and unsaturated zone solvent removal in 2013.	Extrapolation of current groundwater data indicates that termination of these activities should be achieved by the dates stated. The EA have been consulted and have not objected to this conclusion, subject to verification through actual performance.
	The River Thames discharge pipeline will be removed where practicable although the sections that are in-accessible will be capped and grouted.	It is uncertain that, without characterisation and regulatory consultation, approvals can be received to decontaminate, grout, and leave the pipeline in place.
	No significant work, beyond the work required to meet regulatory requirements, is needed to remove the NDA designation of the site.	The NDA have confirmed that no significant work is required to remove the NDA designation of the site after achievement of the necessary regulatory approvals.
Waste & Nuclear Materials Management (12.14)		
	All Intermediate Level Waste (ILW) will be stored on-site, in passively safe states, in appropriately engineered storage facilities, until it is shipped to the Geological Disposal Facility (GDF) starting in 2040.	Although alternatives for ILW disposal or off-site storage may become available before ILW is shipped to the GDF this is uncertain at this time. GDF availability and the frequency for ILW waste transfer will be determined as a part of a national programme.
	The ILW packages in their passively safe condition will be acceptable for disposal in the GDF.	Final package configurations have been or will be approved by NDA, RWMD before use.
	Dragon fuel (HEU) cans will be overpacked into 500 litre drums and grouted for storage in the Vault Store.	The size and fissile content of the fuel cans are expected to meet the NDA, RWMD fissile limits for final disposal.
	Low Enriched Uranium (LEU) will be stored on site in the ILW store until it can be shipped to the GDF. Prior to consignment to the GDF the LEU will be overpacked and encapsulated into final disposal containers.	Disposal in the GDF is appropriate for this LEU if recovery into the fuel cycle is unavailable. NDA has requested another site to consider receiving LEU for use in the fuel cycle. However, no agreement has been reached for the Harwell LEU. Delayed encapsulation does not foreclose options.
	Concrete Lined Drums (CLDs) will be processed and stored on-site.	There is no agreement to process this material off-site.
	A permanent on-site disposal facility for High Volume Low Activity Waste with the necessary EPR 2010 authorisations will be constructed on a delicensed section of the Harwell site and will be available from 2015.	A BPEO consultation has been completed concluding that both on-site and off-site routes are justified. Off-site routes are not currently available.
	Sufficient Low Level Waste (LLW) disposal routes are available to support planned waste processing and decommissioning activities.	The NDA is responsible for providing adequate LLW routes to support its programmes.
	Disposal routes will be available for contaminated oils and solvents and for hazardous and non-hazardous waste with their acceptance criteria taking into account the requirement for OSPAR (Oslo Paris Convention).	RSRL is not aware of any proposals to terminate these disposal routes.
	Radioactive material which is being stored on behalf of or by tenants or other organisations will be removed from the Harwell site by the owner in a timescale that does not impact the decommissioning programme.	The waste owners hold the obligation for their waste removal and disposal. Agreements are in place documenting the owners' obligations.
General		
	Radioactive waste processing and decommissioning will occur as soon as practicable within the constraints of the current NDA annual site funding limit (ASFL) profile.	The NDA sets the ASFL profile for each site based on the total available funding and national priorities.
	The site will transition to a secure storage mode of operations at the B462 Waste Management Facility after all other decommissioning is completed.	ILW must be stored securely on-site until it is shipped to the GDF.

Risk Management

RSRL will make every effort to ensure that activities are completed safely and effectively, using the best available risk management techniques. The main threats and opportunities associated with the Harwell site are outlined below.

Figure 12-30 – Risk summary

Threats	Description
Description	Facilities become structurally unsound before the end of the extended care and maintenance period.
Possible Impact	Significant amount of additional funds would be required to maintain structural integrity before decommissioning or early decommissioning is required.
Mitigation Activities	Perform engineering analyses of the facilities to identify potential issues. Implement maintenance programmes to preserve structural integrity. Prioritise work to allow earlier decommissioning of failing structures.
Description	Significant contamination identified in land areas (open and under buildings) previously assumed to be unaffected or minimally contaminated.
Possible Impact	Significant amount of additional funds would be required to remove and dispose of contaminated soils.
Mitigation Activities	Continue to review historical records and perform characterisation of site land areas.
Description	ILW packages in passively safe condition (as currently agreed) are not accepted in the Geological Disposal Facility (GDF).
Possible Impact	Additional costs and facilities will be required because ILW packages must be repackaged or over-packed prior to shipment to the GDF resulting in extended timescales.
Mitigation Activities	Packages produced in agreement with NDA, RWMD letter of compliance process.
Description	Contact handled ILW packages require treatment in addition to grouting in situ.
Possible Impact	Additional facilities and resources required to treat the waste. Increased risk to operators from waste handling.
Mitigation Activities	Develop robust technical justification of current strategy supported with grouting trials using simulated material. Explore other waste routes. Develop the business case for processing at other sites.
Description	Delicensing criteria cannot be met without removing residual subsurface structures .
Possible Impact	Increased costs resulting from additional excavation requirements.
Mitigation Activities	Develop a robust delicensing case for leaving sub-surface structures in place. Liaise with regulators to ensure that this approach remains acceptable within the delicensing criteria.
Description	Sufficient waste disposal routes are not available to support the decommissioning programme.
Possible Impact	Project end dates would extend increasing programme costs. Waste disposal costs would increase for the next best available alternative.
Mitigation Activities	Continue to assist the NDA and third parties in maintaining existing and identifying new waste disposal routes.
Opportunities	Description
Description	Send special nuclear material to an alternative site for processing rather than treating and storing at Harwell.
Possible Benefit	A reduction in security costs, processing efficiency through economy of scale, a volume reduction if supercompaction facilities are available at alternative site.
Delivery Activities	Develop a final business case for relocation of special nuclear material to appropriate sites.
Description	Relocate ILW to an alternative site before disposal in GDF and accelerate decommissioning.
Possible Benefit	Reduces ILW storage and care & maintenance costs while allowing accelerated decommissioning.
Delivery Activities	Develop a final business case for consolidation of ILW with that of other Site Licence Companies, which will facilitate site closure.
Description	Identify a lower cost off-site waste route for high volume low activity of minimally contaminated waste.
Possible Benefit	Disposal costs would be reduced, LLW disposal facility space requirements would be reduced, and an on-site disposal route would be avoided.
Delivery Activities	Assist the NDA and other third parties to develop an alternative route for minimally contaminated waste.
Description	Leave large portions of the River Thames discharge pipeline in place after decontaminating and grouting.
Possible Benefit	Reduced programme costs and potential environmental advantages from not disturbing large sections of land between the site and the River Thames.
Delivery Activities	Evaluate the best available techniques for the disposal of the River Thames discharge pipeline as part of the future decommissioning strategy.

The risks relating to prevention of safety, security and environmental incidents will continue to be a major priority on the site. Risk handling strategies are implemented via Project Level Mitigation Plans.

Metrics & Key Quantity Curves

Defined metrics and key quantities provide a standard against which the NDA can measure RSRL’s performance, outputs and deliverables. The key metrics that can be used to measure performance and deliverables for the work are given below.

Lifetime Plan key metrics

The key metrics associated with delivering this programme are:

- ILW remaining to be transferred to the Geological Disposal Facility.
- LLW remaining to be disposed of at the national LLW repository.
- The number of buildings remaining to be demolished.
- The area (Ha) of the designated site remaining to be delicensed.
- Safety & Environmental Detriment (SED) Scores.

Figure 12-31 – Waste remaining for disposal or transfer off site

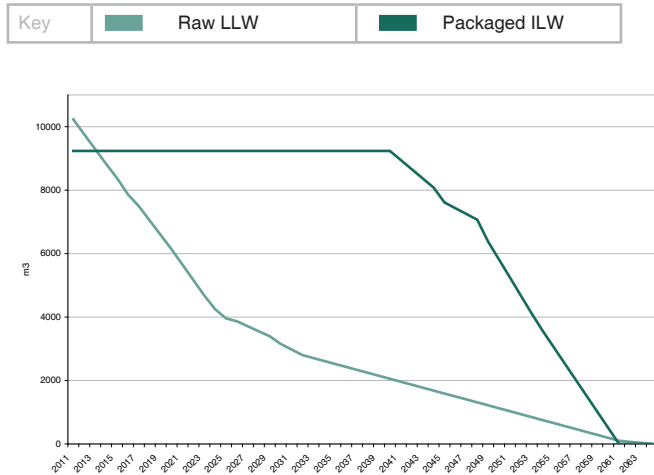


Figure 12-32 – Number of Buildings remaining to be demolished

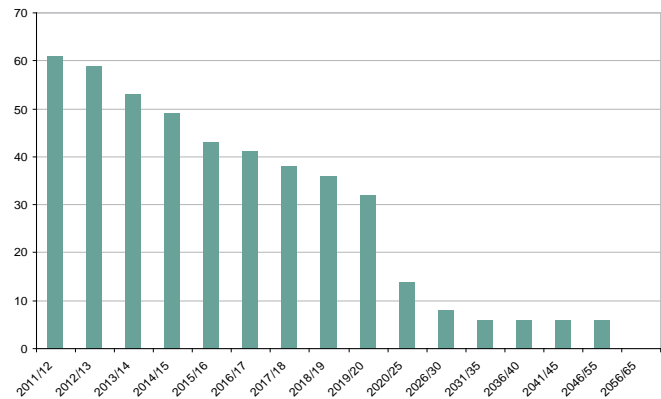


Figure 12-33 – Area remaining to be delicensed (Ha)

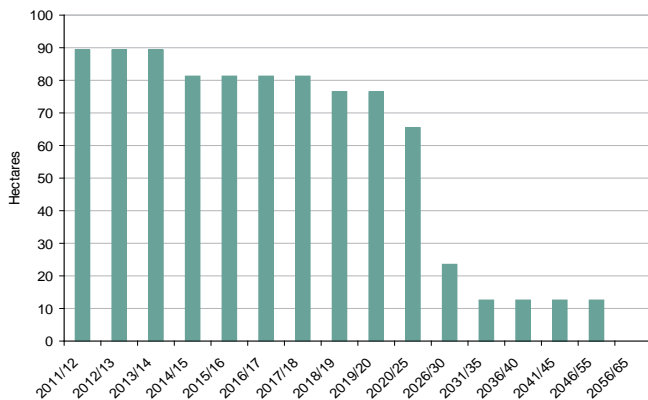
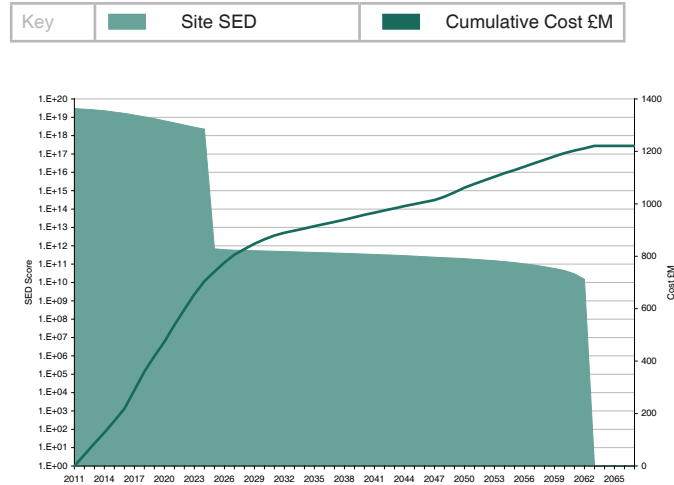


Figure 12-34 – Site Total SED and Cumulative Cost



Conclusion

Decommissioning of the UK's first nuclear research and development site will support the development of world-class science capabilities at the Harwell Oxford Campus.

The purpose of the decommissioning programme is to clean-up the site to allow delicensing and transfer of the property to the Harwell Oxford Campus. A significant part of the programme is processing of historic radioactive materials to prepare it for disposal as ILW, followed by decommissioning of site facilities and remediation of land areas and groundwater. ILW will be stored on site until the national Geological Disposal Facility becomes available after which it will be shipped to the facility and final decommissioning completed.

The RSRL Lifetime Plan provides for progressive reduction of the site hazards. The decommissioning programme will be delivered cost effectively by implementing innovative approaches to working: eliminating activities that are not required, using existing resources efficiently, applying new technologies appropriately, and working effectively with RSRL's supply chain. RSRL will work with its stakeholders to ensure that they are kept up to date with the progress of work activities. RSRL will also consult with its stakeholders and ensure that their views are considered on key decisions.

Finally, RSRL's aim is to deliver the work safely and efficiently and to become the first NDA site licence company to release its sites.





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