

New Low-Level Waste Facilities at Dounreay: 2010 Project Summary

Dounreay Site Restoration Limited (DSRL)¹ needs to manage up to 175,000 cubic metres of solid low-level radioactive waste (LLW) that will be generated from decommissioning of the Dounreay site. An open and consultative Best Practicable Environmental Option (BPEO), undertaken in the period 2000-2004, led to the decision to apply for permission to construct new LLW disposal facilities at Dounreay.

DSRL received planning approval from the Highland Council to construct new disposal facilities in 2009. The planning application was based on an independent Environmental Impact Assessment, site investigation work, design and safety studies, and extensive consultation. This approval represents a significant step in securing the future decommissioning programme for Dounreay. DSRL has also submitted an application to the environmental regulators for authorisation of waste disposal at the facilities, based on an independently prepared and peer reviewed Environmental Safety Case (ESC).

DSRL intends to use the facilities only for disposal of the solid LLW generated at Dounreay and the adjacent Vulcan site. The waste disposal facilities will consist of up to six shallow, sub-surface concrete vaults. The facilities will be located immediately to the northeast of the Dounreay licensed site. Design and construction of the first phase will commence in 2011, with first waste emplacements planned for 2014. Two further phases of vault construction may be undertaken up to a maximum of six vaults. After the vaults are full, the facilities will be closed and the excavation backfilled and the area will be restored using an engineered cap.

Environmental impacts associated with the facilities will be mitigated by meeting the Planning Conditions and implementing a series of environmental commitments that have been made in the Environmental Statement. In addition, a package of community support measures is being put in place in recognition of the strategically important nature of the facilities.

This leaflet summarises the need for the facilities, the approach to LLW management at Dounreay, the design of the New LLW Facilities, and the main safety and environmental issues that have been addressed.

Introduction

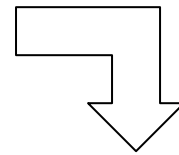
Over the last few decades, nuclear power has met a significant proportion of the UK's electricity needs. The research establishment at Dounreay in Caithness, Scotland, was set up by the UK government in 1955 to investigate and demonstrate the feasibility of advanced nuclear reactor designs. The research programme was terminated in 1994, and the buildings are now being emptied and taken down (decommissioned) by DSRL, on behalf of the Nuclear Decommissioning Authority (NDA). The decommissioning programme at Dounreay will cost around £2.5 billion and will involve the gradual dismantling and removal of plant and facilities on site over the course of the next 25 years or so.

¹ DSRL was established on 1 April 2008 as part of the restructuring of the United Kingdom Atomic Energy Authority (UKAEA). Work prior to 1 April was conducted by UKAEA.

An integral part of the decommissioning programme is the requirement to manage the LLW that will be produced. The LLW Management Project, the subject of this leaflet, was initiated in 1999 to identify and implement the best long-term solution for managing the LLW generated during the restoration of the Dounreay site.



Current Dounreay site layout.



View of the site in 25 years or so, when most plant and buildings will have been dismantled and demolished.



LLW at Dounreay

Solid LLW includes metals and concrete, glass, soils and other materials, such as polythene sheets, plastic gloves and paper, that have been lightly contaminated with radioactivity. It is at the low end of the radioactivity level range in the radioactive waste spectrum. It contains less than 0.01% of the radioactivity that is present in radioactive waste on the Dounreay site, but comprises about 90% of the solid radioactive waste by volume that is expected to be created during operation and decommissioning of the site.

Decommissioning Dounreay over the coming decades is expected to generate between 64,000 and 109,000 cubic metres of packaged LLW. This is equivalent in volume to between 450 and 760 double-decker buses.



Photograph showing typical contents of a drum of Dounreay LLW.

Historically, Dounreay disposed of its own LLW on site in authorised facilities at Dounreay, known as the LLW Pits. It is planned to retrieve that waste, which will generate up to a further 66,000 cubic metres of packaged waste. More recently, LLW has been placed in half-height iso-freight containers (similar to steel road transport containers) and stored in buildings on site as an interim measure. Across the rest of the UK, other nuclear operators currently send their LLW to the national LLW disposal facility near Drigg in Cumbria, using similar waste packages.



Photograph showing storage of LLW at Dounreay.

In 2004, following consultation with stakeholders and members of the public, Dounreay issued the “Best Practicable Environmental Option (BPEO) Report” on the management of Dounreay LLW. The BPEO study involved an assessment of potential management options for the LLW. These options were assessed against a range of criteria, including technical, environmental, cost, health and safety issues. The study was conducted in line with best practice and involved consultation with a range of people, including the local community and organisations with an interest in radioactive waste management. The recommendations and conclusions from the study provided the basis for the “Dounreay Solid LLW Overall Strategy”, which was published in March 2005. A fundamental component of this strategy is the development of new specialised below-ground disposal facilities for LLW at Dounreay. Siting on land at Dounreay avoids any need to transport the LLW away from Dounreay on public roads. Disposal at Dounreay therefore satisfies the proximity principle of managing the waste at source. Disposal at Dounreay is also consistent with the later 2007 UK Government Policy on LLW management, and the 2010 NDA strategy on management of LLW from the UK nuclear industry.

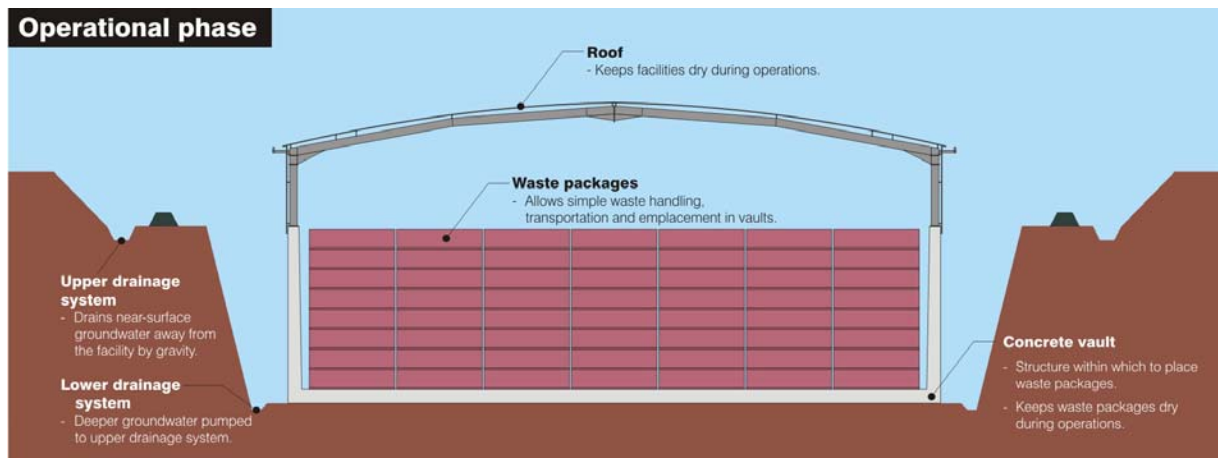
Detailed site investigation, design and assessment studies have since been undertaken, and DSRL has applied for and received planning permission to construct the disposal facilities at Dounreay. A Planning Application was initially lodged with the Highland Council in June 2006. The period for the determination of this application was extended to allow the Scottish Environment Protection Agency (SEPA) sufficient time to assess fully the supporting ESC. The Planning Application was re-activated in May 2008, and Planning Permission was granted by the Highland Council in April 2009. The Planning Permission included some 26 conditions on DSRL, covering a wide range of environmental issues for which the Highland Council is responsible, such as construction noise/dust, traffic and visual impact.

DSRL has also applied directly to SEPA for the necessary authorisation to dispose of radioactive wastes in the facilities. An authorisation from SEPA is required under the Radioactive Substance Act 1993. The ESC has been developed to demonstrate that the waste will be disposed of in a manner that protects the health and interests of people and the integrity of the environment, at the time of disposal and in the future, inspires public confidence, and takes account of costs. The application for the

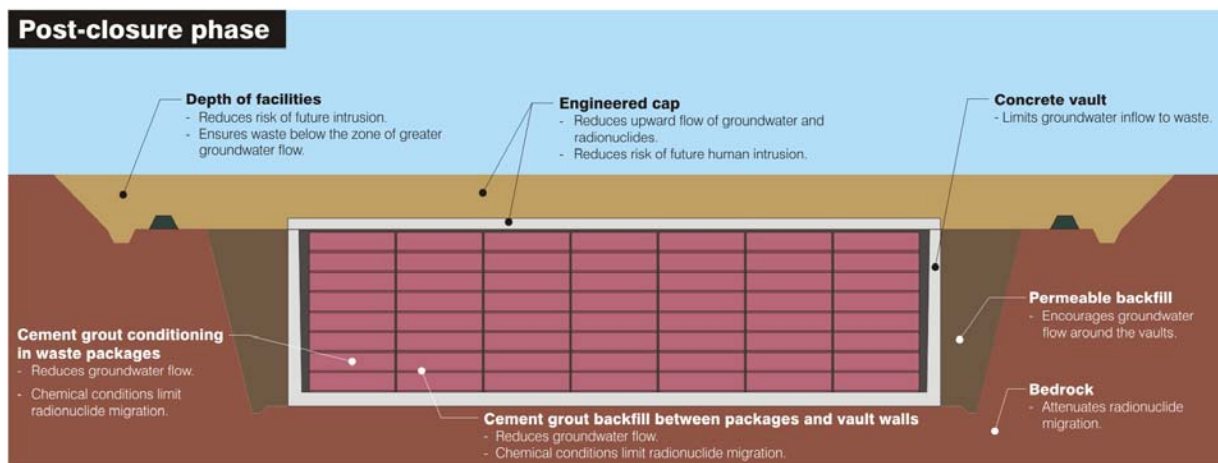
authorisation for the disposal of waste was initially submitted to SEPA in April 2008 and, following dialogue with SEPA, was updated in October 2010. An authorisation with conditions is expected from SEPA during the course of 2011. SEPA will continue to regulate the facilities over their operational lifetime, and until such time after their closure when the facilities can be considered safe to be released from further regulatory control.

The Facilities

The disposal facilities will consist of up to six concrete, sub-surface vaults, constructed in excavations in the bedrock constructed in three phases. During operation the vaults will have roofs to keep the waste dry. Prior to disposal, the LLW containers will be filled with cement-based grout to remove voids and so form a stable cemented block of waste. A grouting plant will be constructed for this purpose. Other required facilities include a pumping system and control building to remove groundwater from around the vaults to allow the vaults to be kept dry while they are being filled with waste. There will also be an administration building, and a water treatment area to remove suspended solids from the water being managed from around the site.



Location – Achieves balance between short-term environmental impacts and long-term sea inundation and potential erosion (applies to both diagrams)



Note: Dimensions are not to scale and figures are illustrative

Illustrations of a single LLW disposal vault during operations (top) and after closure and capping (bottom). The red rectangles illustrate individual LLW containers arranged in the vaults in eight-high stacks.

Prior to closure of the LLW vaults, any spaces around the waste containers will be backfilled with more grout and the vaults will be capped. The cap will include a layer composed of large blocks of rock and will be covered with soil and grassed over. The capping will reinstate the original land surface and will be designed to merge with the surrounding landscape.

Two of the six vaults will be limited to wastes having very low levels of radioactivity and largely in the form of lightly contaminated soils and building rubble – so-called “Demolition LLW”. The Demolition LLW will be disposed of in large nylon bags and emplaced in the concrete vaults without the use of any grout, being backfilled with inert granular material such as sand or crushed rock. This, along with waste compaction during the operational phase, will help minimise voids and stabilise the waste. The Demolition LLW vaults will also be capped after they are full. The cap will be of a somewhat different design to that for the LLW vaults, as it will need to allow for a greater degree of settlement.

Phases of Development

The disposal facilities will be developed in up to four phases:

- Phase 1 is intended to accept waste in 2014 and will accommodate the minimum predicted waste volumes.
- The full extent of phase 2 will be confirmed as the site decommissioning progresses and waste volumes are updated. For example, there may be an opportunity to engineer smaller vault sizes at the start of phase 2 when volumes can be predicted more accurately.
- Phase 3 may be needed to cater for the LLW arising from the planned retrieval of the waste in the existing disposal facility (the LLW Pits).
- The closure phase will involve sealing the vaults, backfilling the excavation around the vaults and emplacing an engineered cap over the vaults. The area will then be restored to blend in as far as is practical with the surrounding environment.

The identification of the preferred location for the facilities involved the consideration of a wide range of factors, including environmental safety and technical issues. It also involved consultation with local residents, representatives and other groups. There is general agreement that the waste should be disposed of at Dounreay. However, there is not sufficient suitable space to construct the facilities on the licensed site itself, and so the facilities have been sited immediately to the northeast of the existing Dounreay licensed site.

The location strikes a balance between long-term safety considerations and the desire to minimise impacts on nearby residents from the construction and operation of the facilities. In particular:

- The facilities are located a sufficient distance from the sea to ensure there is no significant risk from coastal erosion or flooding of the facilities.
- The layout has been adjusted to avoid a major geological fault in the development area, the exact position of which was determined by site investigation work.
- The facilities have been located to minimise, as far as is practicable, potential noise and visual intrusion for local residents.

Other factors were also considered, such as the occurrence of protected species, (e.g. Scottish Primrose), archaeological sites (e.g., the Cnoc-na-h'Uiseig chambered cairn), and the need to minimise the overall "footprint" of Dounreay.

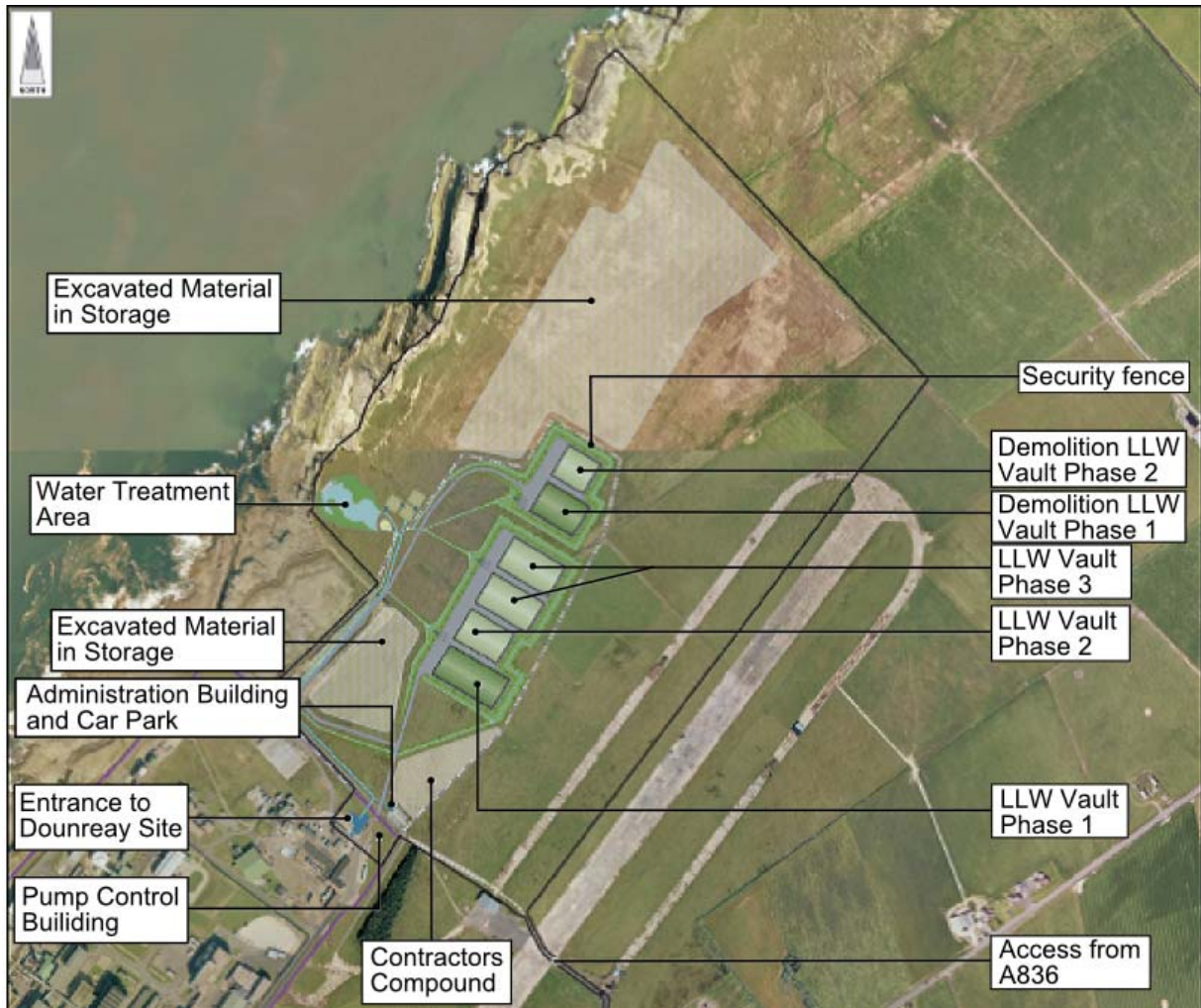


Photo-montage showing location of the planned New LLW Facilities. Black solid line shows site development boundary. The main Dounreay site can be seen in the lower left-hand corner, and the nearest houses and public A836 road are in the lower right-hand corner. The width of the Figure represents about 1,400 metres.

Radiological Safety

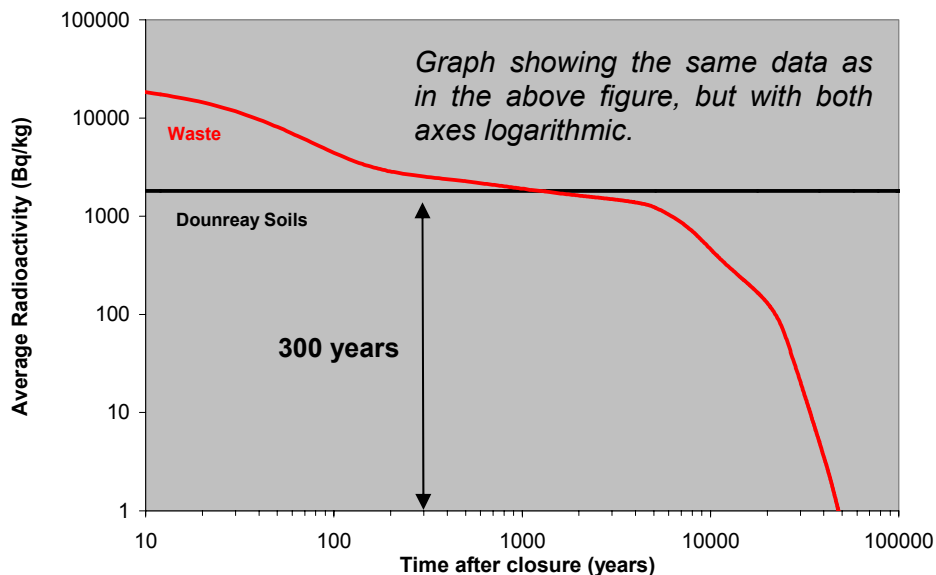
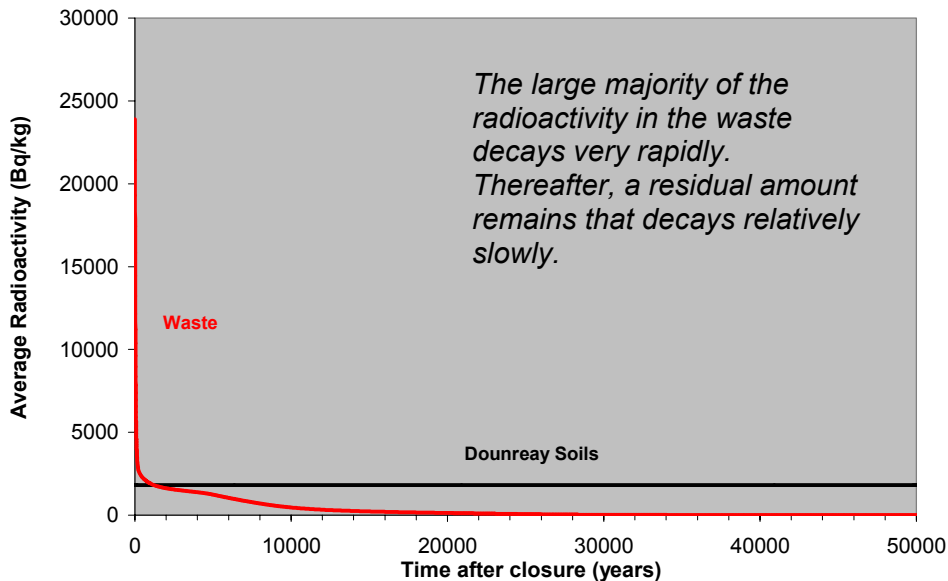
The facilities have been designed so as to contain the radioactive content of the waste within the vaults for as long as is practicable. The radioactivity is contained in two main ways. First, the packaging, backfill, and concrete structure of the LLW vaults restrict groundwater flow through the LLW, reducing the amount of radioactivity that can be leached out. Second, the cement-based grout alters the chemical conditions within the groundwater, effectively binding the radionuclides to the grout, again minimising the amount of radioactivity that can be released.

The radioactivity levels in the Demolition LLW vaults are so low that they pose significantly lower risks to people and the environment and therefore the waste packaging is less robust and no grout is used in either packaging or backfilling.

Following capping and closure of the facilities a period of institutional control and monitoring will follow, to provide assurance that facilities are functioning as intended.

The radioactivity within the waste will reduce naturally over this time owing to the process of radioactive decay. After 300 years, over 95% of the initial activity in the disposed waste will have decayed (see following two graphs). Beyond this period, during which time the facilities and the restored Dounreay area may still be under institutional control, there is little or no hazard associated with the waste and the cap will continue to deter any accidental human intrusion into the facilities.

The ESC explains in detail why the facilities will be safe and will not present a significant risk to people and the environment. The ESC is summarised in a companion leaflet². SEPA has to be satisfied with the safety case before they will authorise disposal of waste.



Graphs showing average radioactivity levels in the waste declining over time owing to radioactive decay. The current natural radioactivity of soils in the Dounreay area is also shown for comparison. The radioactivity level is expressed in terms of Becquerels (Bq; 1 atomic transformation per second) per kilogramme (kg) of material.

² Summary of the Environmental Safety Case 2010 for the New Low-Level Waste Facilities at Dounreay, Scotland. DSRL Report NLLWF/3/ESC/GAL/0516/IS/01, February 2011.

There are many natural sources of radioactivity within the environment that people are exposed to everyday, e.g. radon gas, rocks, soil and cosmic radiation (from the sun). These naturally occurring sources are termed background radioactivity. Assessments have calculated that concentrations of radioactivity in the environment coming from the waste disposed of in the facilities would never exceed levels similar to naturally occurring background radioactivity. Therefore, they never reach levels that might be of concern from the perspective of public health and safety.

The ESC demonstrates that there will be no significant risk to people as a result of the radioactivity in the disposed waste. In addition, the calculated concentrations of radionuclides that might enter the environment in the future are so low that there will be no significant impacts on other fauna or flora.

Other Environmental Impacts

The Environmental Impact Assessment conducted in support of the planning application considered other possible environmental impacts of the facilities during their construction, operation and closure, and beyond. The site selection process sought to minimise many environmental impacts, but some impacts are inevitable, such as noise, dust and vehicle movement during construction. The most significant of these will occur during the vault construction stage, with no significant impacts during operation, and some impacts during vault closure and restoration of the area.

Noise and visual impacts have been minimised by locating the facilities over the brow of a hill and as far from neighbouring properties as is practicable. The lack of a visual impact is illustrated by the line-of-sight section shown on the following page. Noise will be further reduced through implementation of best working practices such as using quiet plant, shrouding of equipment, switching machinery off when not in use, using non-tonal reversing alarms, and temporary screening. In dialogue with stakeholders, consideration is being given to the use of blasting for excavation in order to minimise the duration of the construction period and reduce construction impacts. A programme of noise monitoring at local receptors has been established to ensure noise levels do not exceed established limits during the construction and closure phases.

Impacts to air quality are anticipated mainly through the generation and spread of dust, particularly during excavation and construction. This will be minimised through best working practices, such as using construction equipment designed to minimise dust generation, ensuring vehicles are clean before leaving site, removal of dust-generating materials as soon as is practicable, and cleaning and damping down of roads. The impact has also been minimised by increasing the distance of the facilities from the nearest local neighbours as far as is practicable.

Transport impacts have been minimised through design and location. Keeping the excavated material at an on-site location has a huge effect in minimising vehicle movements on public roads. Further reduction in potentially negative impacts will be achieved through a Traffic Management Plan. This will include measures such as staggering construction site working to avoid Dounreay peak traffic periods, using on-site materials where possible, and agreeing haulage routes to minimise disruption.

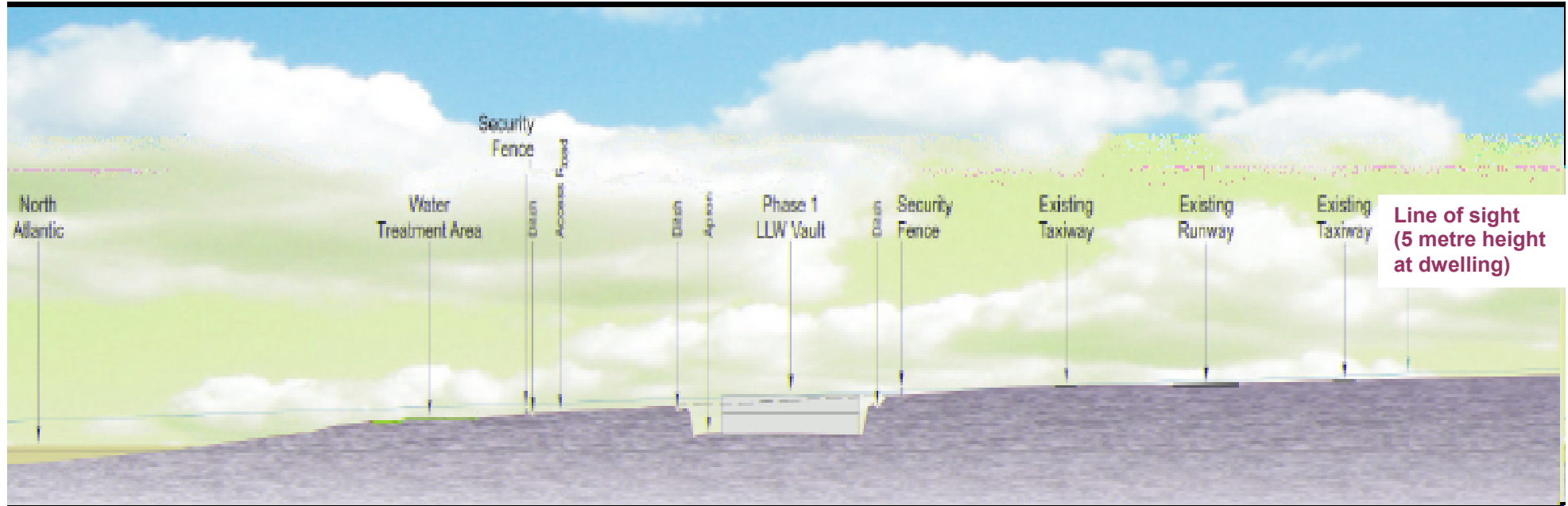


Illustration showing the slope of the land surface and the New LLW Facilities during the operational period, going from the nearest dwellings (right-hand side) to the sea (left-hand side). The line of sight from a height of 5 metres at the nearest dwellings is also shown.

Other environmental impacts have also been assessed, and measures have been established to minimise those impacts. For example, the Scheduled Ancient Monument, Cnoc-na-h'Uiseig, will be fenced off to avoid disturbance. Vault locations are undergoing archaeological monitoring to identify, record and, where appropriate, carefully excavate archaeological remains of cultural heritage value prior to the start of the main vault excavation works.

Disturbance to birds will be minimised through the timing of the commencement of construction and restoration of habitat when the facilities are closed. Impacts on the sea from construction will be minimised through the implementation of a specially designed drainage system.

DSRL will ensure that the mitigation measures identified in the Environmental Statement Schedule of Environmental Commitments are taken forward and incorporated into design and construction contracts to ensure their implementation.

Construction Timescale

A contract for detailed design and construction of the first phase of vaults has been let in early 2011, and the anticipated date for starting construction is mid to late 2011. Site preparatory works commenced in late 2010. It will take several years to complete construction of the first phase of vaults, with the facilities due to become operational in 2014. DSRL will submit an updated ESC to SEPA prior to then to demonstrate environmental safety of the as-built design of the vaults, and to take account of any new information obtained during the first phase of vault construction.

Stakeholder Dialogue and Community Benefits

Dialogue with stakeholders has been a significant input to decisions on the overall LLW management strategy at Dounreay, and on implementing the preferred option of disposal in below-surface vaults adjacent to the Dounreay licensed site. One of the Planning Conditions concerns implementation of a package of community support measures, aimed at socio-economic development of the area around the Dounreay site – this benefits package recognises the acceptance by the Highland Council of a strategically important facility at Dounreay. The NDA has committed to pay £4M to the fund; £1M at start of construction and £300,000 per year for the first 10 years of operations. The fund, called the Caithness & North Sutherland Fund is being established to distribute funding to projects that can help regenerate the area's economy, in accordance with the socio-economic policy of the NDA. The fund's directors have now been appointed and aim to launch the fund in the summer of 2011.

Conclusion

In order to enable decommissioning of the Dounreay site, it is necessary to manage up to 175,000 cubic metres of solid LLW that will be generated. The best option for managing this waste is the construction of new LLW disposal facilities at Dounreay.

The facilities will consist of up to six shallow, sub-surface concrete vaults, into which the waste will be emplaced. A planning application was submitted to the Highland Council for the facilities, and an application for a disposal authorisation has been submitted to SEPA. Both applications include the independently prepared ESC that confirms that the facilities will be safe. Planning Approval was received in 2009, and a conditional authorisation from SEPA to dispose of wastes is expected during 2011. Construction is anticipated to start mid to late 2011.

This is a major project that will cost several tens of millions of pounds. Most importantly, the LLW facilities are fundamental to the successful and efficient decommissioning of the Dounreay site, upon which many more millions of pounds of investment and hundreds of jobs rely. A package of community support measures is being put in place in recognition of the strategically important nature of the facilities.

Additional Information

For those interested in obtaining further information, summaries of both the Environmental Statement and the ESC have been produced. Summary papers explaining the issues associated with site selection, coastal erosion and mitigation of environmental impacts have also been produced. All of these summary documents, along with the Environmental Statement, the ESC and other key project documents, are available on the DSRL website: <http://www.dounreay.com/waste/radioactive-waste/low-level-waste/new-low-level-waste-facilities>.

We welcome comments on these summary papers and other project documentation.
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