Magnox

Strategic Environmental Assessment
Site Specific Baseline

Bradwell Site

FOREWORD

This document has been prepared to support the NDA's Strategic Environmental Assessment of its decommissioning strategy for the 10 Magnox Sites. This document contains baseline environmental information and other relevant environmental data.

STRATEGIC ENVIRONMENTAL ASSESSMENT
Site Specific Baseline

Bradwell Site
Bradwell-on-Sea
Southminster
Essex
CM0 7HP

Bradwell Site

Bradwell Site is a twin reactor Magnox station undergoing decommissioning, and is located close to the village of Bradwell-on-Sea in the Maldon District of Essex, South East England. It is situated on the south bank of the Blackwater Estuary, from which it drew cooling water supplies during its operational phase, on the northern coast of the Dengie Peninsula. The site covers an area of approximately 20 hectares [4]. The following describes the key dates for Bradwell Site:

- Construction of Bradwell Site commenced in 1957, and electricity was first supplied to the grid in 1962 [1].
- The site ceased electricity generation in 2002 after 40 years of operation [1].
- Defuelling of the reactors was completed in 2006 [3].
- The Care and Maintenance Preparations (C&MP) phase of the decommissioning process is scheduled to be completed in 2015, and the Care and Maintenance (C&M) phase is scheduled to last 68 years, until 2083 [3].
- The Magnox Optimised Decommissioning Plan (MODP) was implemented in 2010, and Bradwell was identified as one of the two 'accelerated sites', for which several key decommissioning projects have been accelerated. Decommissioning of the site had previously been deferred, so the accelerated dates are similar to the original projections for completion of key decommissioning milestones [2].
- Final Site Clearance (FSC) is scheduled to commence at the end of the Care and Maintenance phase, taking 9 years to complete, with all remaining structures on the site cleared by 2092 [3].

1. Magnox Ltd (2011) Bradwell – Facts and Figures. Available at http://www.magnoxsites.co.uk/our-sites/bradwell/facts-and-figures
2. Magnox Ltd (2011) Bradwell Site Integrated Waste Strategy (IWS)
3. Nuclear Decommissioning Authority (NDA) Strategy Document, 2011
4. Magnox South (2010) Bradwell Site – Land Required for Operational Purposes

Site End State Assumption

The planned end state for Bradwell Site is defined in the NDA Strategy Document 2011. This states: *'Radioactive and non-radioactive contamination will be reduced to meet the requirements of the relevant regulatory regime for the next planned use of the site and the current use of adjacent land. Where the next planned use no longer requires a nuclear site licence, radioactive contamination will be reduced to meet the criteria for delicensing, with any remaining radioactive substances being subject to the relevant environmental permitting regime. The physical state of designated land will be made suitable for the next planned use of the site; structures and infrastructure will be made safe or removed where necessary, having first explored opportunities for their re-use.'*

Current Environmental Baseline

Table 1: Baseline Data for all SEA Objectives for Bradwell Site

SEA Objective	Environmental Baseline Data	References
Air Quality	Radioactive Discharges • Aerial discharges of radioactivity have reduced since the cessation of generation. The reactor cores at Bradwell are enclosed within Steel Pressure Vessels (SPVs), which are in turn contained within concrete structures ('bioshields') designed to protect site personnel from radiation originating from within the cores [1]. During operations discharges of aerial activity resulted from ventilation of the bioshield voids, which released gaseous activation products when the reactors were under load. • Periodic venting of reactor coolant gas was carried out during the operational phase. This has ceased since the end of generation. • Nuclear operations including waste retrieval which are being undertaken as part of the decommissioning works result in minor but regular aerial discharges of radioactivity in compliance with the site Environmental Permit. . Conventional Discharges • Vehicles and diesel generators are employed on Bradwell Site, which are sources of air quality contaminants including NO_x (oxides of nitrogen), SO_x (oxides of sulphur), O_3 (ozone) and PM_{10} (particulate with a diameter <10µm). These sources run only intermittently, and due to the rural nature of the site average levels of these pollutants are likely to be low. • Discharges from these sources will likely remain steady throughout the C&MP phase. • Dust is currently, and will in future, be generated from construction and demolition activities undertaken on the site as part of C&MP. Mitigation of this dust is undertaken in all instances.	
Global Climate Change and Energy	• Throughout its lifetime Bradwell Site has drawn power from the National Grid to satisfy domestic power needs (heavy plant items such as the gas circulators and cooling water pumps were driven by power derived directly from the station's output). The use of this energy has resulted in indirect CO_2 emissions, due to the mixed generation used in the UK. • At Bradwell Site auxiliary equipment for the provision of emergency backup power consists of portable diesel generators. These machines are not in constant use; instead they are there for emergencies, but are regularly run for testing purposes. • Approximately 30 different types of vehicle (including vans, forklift trucks, tractors) are based at Bradwell Site, which are either used within the site footprint, or move from the site to further afield (e.g. vehicles used in carrying out the District Survey), and have associated carbon emissions. Indirect carbon emissions originate from the use of hire vehicles by site personnel when travelling on company business in addition. • Magnox Ltd. has registered under the Carbon Reduction Commitment (CRC) and also has a company-wide Energy Efficiency Policy. Both of these schemes are currently being implemented on a site by site basis, with the aim of minimising greenhouse gas emissions across the company.	
Biodiversity,	• Bradwell Site is situated in a predominantly rural setting, and has 9 statutorily designated areas in close proximity [1].	1. Magnox South

Flora and Fauna	• These designations recognise the importance of the area for its estuarine habitats in general, for specified plant communities and habitat features, and for a wide range of species dependent on these.
	  • Blackwater Estuary Site of Special Scientific Interest (SSSI)
	  • Blackwater Estuary National Nature Reserve (NNR)
	  • Dengie Flats SSSI
	  • Dengie Flats NNR
	  • Colne Estuary SSSI
	  • Colne Estuary NNR
	  • Mid-Essex Coast Ramsar
	  • Mid-Essex Coast Special Protection Area (SPA)
	  • Essex Estuaries Special Area of Conservation (SAC) [1] .
	• These designations recognise the importance of the local estuarine habitats in general, whilst the SPA and Ramsar designations relate to the various wintering and breeding birds found locally specifically. Due to these designations the coastline adjacent to Bradwell is also classified as the Essex Estuaries European Marine Site [3] [1].
	• The site Biodiversity Action Plan considers how the site manages its impacts on local ecosystems. This document is reviewed and updated on a regular basis.
	• The Environment Agency (EA) concluded that exposure to ionising radiation from authorised discharges of radioactivity from the UK's nuclear installations did not significantly impact wildlife in England and Wales [2].
		(2009) Bradwell Site Environmental Impact Assessment Baseline (EIAB)
		2. Environment Agency (2002) Impact Assessment of Ionising Radiation on Wildlife
		3. Natural England (2011) England's European Marine Sites, available at http://www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/europeansites.aspx

Landscape and Visual	• Bradwell is located on the north coast of the Dengie Peninsula, on the Blackwater Estuary [1]. • A large proportion of the land adjoining the estuary lies below 5 m Above Ordnance Datum (mAOD) [2]. • The area in which Bradwell Site is situated is characterised by openness and expansive views, and apart from the site itself the area lacks any large industrial buildings [2]. • Tree cover within this landscape is sporadic, and in close proximity to the site is concentrated in hedgerows, copses and individual trees. This vegetation cover alleviates some of the site's visual impact, especially in summer [2]. • The site is highly visible from the estuary especially at medium-long distances [2]. • There are no international or national landscape designations in the locality of the site. A special landscape area is designated locally by Essex County and Maldon District Council [2].	1. Ordnance Survey (2011) 1:25,000 Sheet 175, Southend-on-Sea and Basildon 2. Magnox South (2009) Bradwell Site EIAB
Cultural Heritage	• There are 9 Scheduled Ancient Monuments with 5km of Bradwell Site, with the nearest being Pewet Island Saxon Fish Traps and the Othona Roman Fort. • There are 2 Grade I, 7 Grade II* and 149 Grade II Listed Buildings within 5 km of Bradwell Site. • There are no entries in the draft Register of Landscapes, Parks and Gardens of Special Historic Interest, as listed by Natural England, near to Bradwell Site. • Nearby sites of archaeological interest include Neolithic settlements and WWII coastal defences (Pill boxes). • Bradwell Site is built at the periphery of an WWII era airfield (which is part of the NDA landholding), but there are no known archaeological features of importance within the site boundary.	Magnox South (2009) Bradwell Site EIAB
Groundwater,	• Reworked clays, silts and sands comprise the made ground that immediately underlie the site. The superficial (drift)	Magnox South (2009)

[1] Where an SPA or SAC is continuously or intermittently covered by tidal waters or includes any part of the sea adjacent to the UK, the site is referred to as a European Marine Site.

Geology and Soils	deposits near Bradwell Site are a thin layer of Marine / Estuarine Alluvium, consisting of clay and peats with sand lenses, underlain by sands and gravel. • The bedrock at Bradwell Site consists of a thick layer of the Tertiary age London Clay, a stiff fissured clay of marine origin. This is underlain at depth by the Cretaceous Chalk basement rock. • The sand and gravel deposit is considered a Minor aquifer, with the alluvium classified as a non-aquifer. This results in a patchy shallow water table, with localised perched groundwater in the sand lenses in the alluvium and in the sand / gravel layer. • The London Clay is considered a non-aquifer, but the underlying chalk at depth comprises a Major aquifer of regional importance. • An abstraction is made 3km from the site at Eastlands Farm for general agricultural purposes (given the depth to and protection extended to the Major aquifer, this is assumed to be a shallow borehole). • The soil in the area surrounding Bradwell Site is classified as free draining acid soils and peats, and is classified primarily as a Grade 3 agricultural quality soil, with localised areas of grade 1 and 2 soils in the site's locality. <u>Land Quality</u> • Bradwell Site contains a number of known areas of radioactive and non-radioactive contamination. • The radioactively contaminated ground is primarily associated with the Old Active Effluent Discharge Line at the north end of the site, which leaked during the operational period. This resulted in the contamination of a significant quantity of soil adjacent to the pipeline, such that additional controls had to be introduced within that area. This included contamination control areas and fencing. • The Decontamination Bay sump is also known to contain radioactive contamination. • Remedial works have already been undertaken which resulted in the removal of approximately $100m^3$ of contaminated spoil. Site investigation is ongoing. • The chemically contaminated ground is mostly due to hydrocarbon contamination north of Reactor 1 and within the non-radioactive area (including the turbine hall) resulting from spills and leaks. A quantity of buried asbestos is potentially buried in the northern portion of the site, additionally.	Bradwell Site EIAB
Surface Water Resources and Quality	• The nearest watercourse to Bradwell Site is the Blackwater Estuary. No other watercourses flow into the estuary close to the site [1]. • The ecological and chemical status of the Blackwater Estuary is considered moderate in the vicinity of the station, and good downstream, under the Water Framework Directive [2]. • The tidal range in the Blackwater adjacent to the site ranges is from 5.2m above Chart Datum (2.52 above AOD) at mean high water spring tide to 0.4m above chart datum (2.28 below OD) at mean low water spring tide [3]. The area of the site containing the main structures is in the EA fluvial/tidal Flood Zone 1 (so would be affected by floods less frequent than 1 in 1000 years) [3]. • Aqueous effluent discharges (and cooling water discharges during the operational phase) have always been made to the Blackwater Estuary. This was carried out through a dedicated subsurface culvert that carried effluent to a discharge point within the Estuary. • The dispersion characteristics of the Blackwater Estuary are affected by factors including flow rate, sediment load, sedimentation rate, freshwater / seawater mixing rate and tidal range and atmospheric conditions. • Waterbodies containing clay mineral-rich sediments may have higher uptake potential for radionuclide anions such as Cs-137. • The dissolution of Magnox Fuel Element Debris (FED) is planned to commence at Bradwell Site in mid-2012, which will necessitate the discharge of the resulting effluent to the Blackwater Estuary. The radioactivity and heavy metals in the	1. Ordnance Survey (2011) 1:25,000 Sheet 175, Southend-on-Sea and Basildon 2. Environment Agency (2002) Water for Life and Livelihoods – River Basin Management Plan Anglian River Basin District 3. Magnox South (2009) Bradwell Site EIAB

	discharge from this process will be abated. Nitrates in the effluent have been considered, and there is confidence that the process won't result in the exceedance of environmental limits. As such, no change in the site's liquid discharge authorisation levels for radioactivity are anticipated to be necessary due to the implementation of FED dissolution, and an application to cover for anticipated nitrate and other conventional elements has been submitted to the EA. • A variation for Article 37 is being submitted, but is only relating to gaseous emissions (it does not mention the liquid aspects). The discharge application is in the process of being evaluated by the EA.	
Waste	• Both operational and decommissioning activities at nuclear sites generate radioactive and conventional waste. • Low Level Waste (LLW) is generated at Bradwell Site from a range of routine operational and decommissioning activities, and comprises a range of different materials. • The baseline for LLW is to package the waste and send it to the Low Level Waste Repository (LLWR) near Drigg in Cumbria for disposal [1], other treatment options are utilised where possible, these include metal melt and incineration. • Opportunities to characterise or decontaminate to Very Low Level Waste (VLLW) or exempt (for permitted landfill), size reduce, incinerate or metal melt, in order to reduce LLWR consignments, are actively sought [1]. • Intermediate Level Waste (ILW) is generated from both operational and decommissioning activities. The majority of this waste will be retrieved from storage locations, such as the active waste vaults during C&MP when an ILW store becomes available on site. The exception to this are some Miscellaneous Activated Components (MAC) stored in vaults in the concrete bioshield which will be retrieved during FSC [1]. <u>Site Waste Strategy Baseline</u> • The use of self-shielding Ductile Cast Iron Containers (DCICs) for interim storage and eventual final disposal of solid and wet (which is dried within the container) ILW is being pursued by Magnox Ltd., and is to be implemented at Bradwell Site. This is supported by generic and site-specific options studies, but will also be subject to regulatory approval. • The waste packages will be emplaced in the site ILW store for interim storage pending eventual phased transfer to the UK national Geological Disposal Facility (GDF) circa 2040 (but possibly as early as 2029) [2]. • The Magnox FED waste stream has a volume of 558m^3. Dissolution of this waste is due to implemented in mid-2012, which involves dissolving the metal in dilute nitric acid, retaining the bulk radioactivity in the residue, whilst allowing the magnesium salts and other dissolved metallic species to be discharged. After consultation with the NDA, Stakeholders and Regulators the site baseline was altered from encapsulation to dissolution, due to the benefits that this process offers [1].	1. Magnox Ltd (2011) Bradwell IWS 2. DECC (2011) Implementing Geological Disposal Annual Report April 2010 – March 2011 3. Walters S (2009) Fuel Element Debris Status Overview
Traffic and Transport	• The main vehicular access to Bradwell site is described as follows: '*from the national highway network is by way of the A12 London – Ipswich trunk road and the A414 to the west of Maldon. The most appropriate route for HGVs is via the B1018 to Latchingdon, followed by the unclassified C111 through the settlements of Mayland and Steeple, and then the B1021 to Bradwell site avoiding Bradwell-on-Sea village'* [1]. • The nearest railhead to Bradwell Site is on the Crouch Valley Line that runs to Southminster. This fully operational line runs regular passenger services. The nearest passenger rail station is Southminster. • The Average Annual Daily Traffic (AADT) stated in the 2002 baseline for Bradwell Site was in the range 900-13750 vehicles on the main route to the site, of which between 50 and 700 of these vehicles were Heavy Goods Vehicles [2].	1. Magnox South (2009) Bradwell Site EIAB 2. BNFL plc (2002) Bradwell Nuclear Station Environmental Statement
Land Use and	• Bradwell Site occupies an area of 20 hectares [1].	1. Magnox South

Material Assets	• Bradwell Site consists of two reactor buildings, an ILW vaults complex, various ancillary and support buildings, access roads, grassy areas and areas of hardstanding. • The surrounding area is rural in nature and is used primarily for agricultural and recreational purposes. • Notable uses in proximity to Bradwell Site include a coastal footpath that runs immediately adjacent to the site. • Bradwell Site incorporates a significant quantity of material that is potentially eligible for direct reuse or recycling: • This includes a substantial quantity of recyclable metal in the boilers, the gas ducts, the SPVs, and as rebar incorporated into large concrete structures such as the bioshield [2]. • A proportion of this recyclable metal will be made available for recycling during the C&MP phase, such as the boiler house de-plant and other general building dismantling. • The boilers, the primary circuit, the bioshield and the SPVs will be dismantled at FSC, so the majority of the recyclable metal on site will be produced at this time. A proportion of this material will be classified as ILW (activated reactor components in particular) so will likely not be suitable for recycling (and will likely be packaged and consigned to the GDF), but the remainder will be LLW or exempt, and as such may be eligible for recycling and reuse within or outwith the nuclear industry [2]. • A large volume of inert concrete and masonry rubble will be produced through demolition activities during C&MP and FSC, and will likely be reused on- or off-site as infill material, or similar [2].	(2010) Bradwell Site – Land Required for Operational Purposes 2. Magnox Ltd. (2011) Bradwell Site IWS

Noise and Vibration	• The Baseline Noise Survey Data (LAeq, dB(A) (Daytime)) is as follows:
	  • Downhall Beach Estate – 51.4
	  • Down Hall / Trusses Road – 55.6
	  • Coastal Footpath – 53.2
	  • Bradwell Waterside – 53.4
	• The criteria for the significance of noise are the proximity of noise sources to the receptors, and the presence of any screening / nature of the ground between the source and the receptor.
	• Noise and vibration originate from a number of sources at Bradwell Site.
	• Since the cessation of generation the profile of noise and vibration from the site has changed, but remains significant due to the nature of decommissioning works.
		Magnox South (2009) Bradwell Site EIAB

Table 2: Environmental Discharge Data for Baseline Years 2008 – 10 and predicted changes for Bradwell Site

In addition to the baseline information, which describes the permanent, semi-permanent and inherent features and impacts of Bradwell Site and its surrounding area, the following table outlines discharge data for the site for particular years, and how these quantities will likely change in future. This is intended to provide a quantitative 'snapshot' of the features of the site and impact that it has (and is anticipated to have in future), in order to supplement the baseline information.

SEA Objective	Environmental Discharge Data	Future Changes in Environmental Discharges	References

Air Quality	• The following describes the composition of radionuclides comprising the total radioactivity released by Bradwell Site to atmosphere in 2008:
	  • 0.00691 TBq of H-3 (<1 % of annual limits)
	  • 0.00116 TBq of C-14 (<1 % of annual limits)
	  • 1.91 x 10^{-7} TBq of beta (<1 % of annual limits) [1].
	• These 2008 discharges were assessed to result in doses to the critical group of 6 µSv (from consumption of milk and vegetables, with infants as the most exposed group; 0.6% of the public dose limit) [2].
		• As decommissioning progresses through the C&MP phase the trend will be for discharges to remain steady or continue to decrease.
		• Certain decommissioning activities such as the as the retrieval, treatment and passivation of wastes may result in short term spikes in aerial discharges of radioactivity.
		• Civil works during C&MP such as the construction of the ILW store will generate dust.
		• Once the major hazard reduction projects have been completed and the site enters the extended, quiescent C&M phase, aerial discharges of radioactivity will be extremely low.
		• The degassing of desiccant material in storage, bioshield concrete and core graphite may result in very minor discharges of tritium.
		• Dust from demolition and traffic movement may affect the local area during all 3 decommissioning phases. Civil works will be a source of dust.
		• FSC will result in a temporary increase in aerial discharges of radioactivity. This is because the radioactive reactor cores and associated equipment and infrastructure will be dismantled at this point. Detailed estimates for the discharges from this process have not been made, but will likely comprise particulate as major remaining structures are demolished.
		• Retrieval of waste packages from site for transfer to the GDF when it becomes available during the C&M phase will result in traffic movements to the site. This retrieval will likely be phased over an extended period of time, so the impact from this is likely to be limited.
			1. FSA (2009) Radioactivity in Food and the Environment 14
			2. Magnox North and South (2008) Monitoring Our Environment

Global Climate Change and Energy	• In 2010 3843 MWh of energy was used at Bradwell Site. • This energy consumption resulted in the indirect emission of 2370 tonnes of CO_2, and 500 tonnes of direct emissions. • Indirect emissions of CO_2 from sources other than those associated with energy consumption amounted to 30 tonnes.	• The site will draw power from the grid and operate plant and vehicles for decommissioning works such as ILW processing and for general domestic needs until the completion of C&MP. • During C&M the site's power usage will be very low, but periodic inspections and maintenance will result in very small spikes in energy usage. • The retrieval of waste packages from the site ILW store during C&M will result in intermittent vehicle movements to and from the site. Energy use and the operation of numerous vehicles will resume on a significant scale during FSC. • However, the types of the vehicles in use and the nature of energy mix in use in the UK at these dates cannot be predicted, thus the associated CO_2 emissions relative to the present are unknown.	Magnox Ltd. (2011) EHSSQ Company Statistics
Surface Water Resources and Quality	• The following describes the composition of radionuclides comprising the total radioactivity released by Bradwell Site to the estuarine environment in 2008: • 0.02 TBq of H-3 (<1 % of annual limits) • 0.0545 TBq of Cs-137 (7.8 % of annual limits) • 0.0543 TBq of other radionuclides (7.8 % of annual limits) [1]. • These 2008 discharges were assessed to result in doses to the critical group of 6.2 µSv (from external exposure and consumption of seafood; 0.62 % of the public dose limit) [2].	• Discharges of aqueous radioactivity decreased significantly upon the cessation of generation and dispatch of all the spent fuel to Sellafield. • As decommissioning progresses through the C&MP phase the trend will be for discharges to continue to decrease. • Certain decommissioning activities such as the retrieval, treatment and passivation of wastes may result in short term spikes in aqueous discharges of radioactivity. • The dissolution of FED will result in the discharge of magnesium salts to the marine environment, but only very limited amounts of radioactivity, and no change to the water quality status of the Blackwater Estuary. • Once the major hazard reduction projects have been completed and the site enters the extended, quiescent C&M phase, aqueous discharges of radioactivity will be very low, but not zero [3]. • It is possible that during the decades-long C&M phase percolating ground- and rainwater may entrain and mobilise activity from contaminated structures such as areas of the Safestore buildings. Routine monitoring and inspection will identify if this is occurring, and intervention will be undertaken in line with the requirements of the C&M Safety Case to ensure that any activity does not migrate off site. • FSC will result in temporary discharges of aqueous	1. FSA (2009) Radioactivity in Food and the Environment 14 2. Magnox North and South (2008) Monitoring Our Environment 3. Hunt C. (2011) BPM for Water Management during C&M, Bradwell Site, BRAD/BPM/017

		radioactivity, primarily from waste treatment as the radioactive reactor cores and associated equipment / infrastructure are dismantled. Detailed estimates for the discharges due to this have not been made, however.	
Waste	• The following waste metrics are for 2010: • Bradwell Site produced 2280m^3 of LLW from decommissioning activities which has been reused, recycled or disposed of [1]. • 28.8m^3 of LLW metal was recycled, 46.2m^3 of combustible LLW was treated, 43.2m^3 of compactable LLW was treated and 58.5m^3 of LLW was disposed to LLWR [1]. • 4914.9 tonnes of inert waste was produced by the site from decommissioning activities. 100% of this total was recycled [1]. • 1161.6 tonnes of non-hazardous waste was produced from decommissioning activities. 86.3% of this total was recycled [1]. • Both Reactors 1 and 2 are fully defueled [2].	• The anticipated future arisings of radioactive and conventional waste are outlined in Table 4.	1. Magnox South (2010) Nuclear Industry Sector Plan, Waste Metrics 2. Magnox Ltd. (2011) Bradwell Site IWS

The following table illustrates further parameters that are significant for the site.

Table 3: Additional Data for baseline Years 2008 – 10 and predicted changes for Bradwell Site

SEA Objective	Additional Data	Changes in Additional Parameters	References
Surface Water Resources and Quality	• In 2010 the site consumed 24000 m^3 of mains water.	• Water consumption at the site is likely to continue for the duration of the C&MP period at a similar level.	Magnox Ltd. (2011) EHSSQ Company Statistics

Economy, Society and Skills	• Bradwell Site is located in a rural area of the Maldon District in the county of Essex [1].
	• The major settlements within 10km of Bradwell Site are Bradwell-on-Sea to the northwest, Tillingham to the south and Southminster and Burnham-on-Crouch to the southwest, and a number of other smaller settlements in addition [1].
	• The population of Maldon District was 62900 during 2009 [2].
	• Maldon District had a working population of 30700 during 2010 [2].
	  • The dominant working sectors in Maldon District during 2008 were Distribution, Hotels and Restaurants (4500, 23 %) and Public Administration, Education and Health (3700, 19 %)
	  • In December 2010, 179 staff, 60 project staff, and a significant number of contractors* were directly employed by Bradwell Site [3].
	  • Employment in the Electricity, Gas and Water Supply industry in Maldon District was not listed, but the effect of employment at Bradwell Site is likely to be low against the total working population of this district.
	• In 2010 7900 (20%) of the population were employed to NVQ4 level or above.
	• Maldon District is not subject to Convergence Funding from the European Union, or other external assistance [4].
	
	* Contractor numbers are variable, depending on the work being undertaken at the site.
		• The number of personnel employed on site will decrease significantly after the completion of C&MP.
		• Personnel numbers at the site will increase again for the duration of FSC.
			1. Ordnance Survey (2011) 1:25,000 Sheet 175, Southend-on-Sea and Basildon
			2. Office for National Statistics (2011) Official Labour Market Statistics, available at http://www.nomisweb.co.uk/
			3. Magnox Ltd (2011) Industrial Safety Stats @ December 2010
			4. EU (2011) Cohesion Policy 2007 – 13, available at http://ec.europa.eu/regional_policy/atlas2007/index_en.htm

Traffic and Transport	• The AADT from all traffic movements on the A414 (a route connecting the site to the A12 from the north, via Maldon) from recent measurements was 15943, of which 686 were Heavy Goods Vehicles (HGV) movements. • On the A132 (a separate possible route to Bradwell to the south, via South Woodham Ferrers) the AADT from all traffic movements was 24683, of which 907 were HGV movements. • These were the most local count points that were available. • The proportion of these total movements that are directly attributable to Bradwell Site is very low, and will continue to be so even during periods of increased work at the site.	• It is anticipated that general traffic and HGV movements will remain steady or increase during the remainder of the C&MP phase at Bradwell Site. • Higher numbers of personnel will be on site due to the requirements of MODP, meaning that the daily commuting movements will likely be maintained. • Movement of materials for potential future major construction or other projects e.g. delivery of DCICs to site, construction of the site ILW store will generate extra traffic movements, as will movement of demolition waste and other inert material for reuse or conventional disposal. • A similar increase in traffic flows on local roads can be expected for the duration of the FSC phase.	Department for Transport (2011) AADF Home, available at: http://www.dft.gov.uk/matrix/search.aspx
Health and Safety	• Bradwell Site had 0 reportable Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) incidents during 2010 [1]. • The Occupational Safety and Health Administration Total Recordable Incident Rate (OSHA TRIR) for Bradwell Site in 2010 was 0 [1].	• The current Health and Safety regime will likely continue to be enforced for the remainder of the C&MP phase. • Comparable Health and Safety standards to the current ones will likely be enforced during the periods of the C&M phase when personnel are on site for waste package retrieval activities, inspections etc. • Comparable Health and Safety standards will likely be enforced during the FSC phase.	Magnox Ltd (2011) Industrial Safety Stats @ December 2010

Table 4: Future Radioactive and Conventional Waste Arisings for Bradwell Site 2

Category of Waste	Time of Arising	Unpackaged Volume (m3)
LLW	C&MP	5337
	C&M	100
	FSC	38326
ILW	C&MP	1143
	C&M	0
	FSC	3611
Inert, hazardous and non-hazardous conventional	C&MP	92370
	C&M	0
	FSC	80725

(Bradwell Site IWS, 2011)

[2] Packaged volume is between 20 – 50% greater than the unpackaged volume, depending on the type of container and encapsulant applied (UK Radioactive Waste Inventory, 2007).

Main Environmental Issue for Bradwell Site

Land Quality

- There is radioactive and non-radioactive contamination at Bradwell Site, resulting primarily from historic (during the generation phase and from the site's previous usage) events.
    - The radioactively contaminated soil is primarily associated with the Old Active Effluent Discharge Line, and is localised around the path of the former pipeline. Part of this area has been partially remediated by excavation, with the contamination spoil backfilled into the voids with liners in place (with access restrictions and physical barriers to the area in place). There are areas containing lesser levels of contamination outwith the excavated area for which monitoring is ongoing. Radioactive contamination is also present within the Decontamination Bay sump.
    - The chemically contaminated soil is associated with leaks and spills of hydrocarbons. Kerosene contamination has been identified to the north of Reactor 1 (reflecting the site's former use as an airfield), whilst other minor sources of hydrocarbon contamination are present in the conventional areas where significant quantities of hydrocarbons were stored and used, including the turbine hall. No active remediation has been applied to this contamination as of yet. An unauthorised asbestos burial tip is suspected in the northern portion of the site, additionally.
- Monitoring and investigation of these land quality issues is being actively undertaken as part of the MODP programme at Bradwell Site.

FED Dissolution

- The implementation of FED Dissolution at Bradwell Site from 2012 will result in increased discharges (compared to recent historic levels) for the duration of the project. A large part of the southern area of the Dengie Peninsula is designated as a Nitrate Vulnerable Zone, so nitrate concentrations in nearby watercourses (River Crouch, Blackwater Estuary) are of potential concern [1]. The discharges from Bradwell are considered in the context of the current condition of the Blackwater Estuary, and also the anticipated duration of discharges originating from the project. A modification to the discharge authorisation in respect of nitrates and other conventional elements has been submitted to the EA.

Climate Change and Flooding

- As with all of the coastal Magnox Sites, an ongoing issue for Bradwell during the C&M phase is the vulnerability of the site to flooding due to raised sea level and more frequent storm surges brought about by the anticipated effects of climate change in the coming decades. This is due to the generally low lying coastal situation of the site.
    - The C&M phase at the site, during which the reactors will be in Safestore, is scheduled to last until 2083, by which approximate time (2090-99) the Intergovernmental Panel on Climate Change has projected that the worst case scenario (emission scenario A1FI) of sea level rise is in the range 0.26 – 0.59m (relative to 1990-99 levels) [3]. The site is situated at an elevation of 5.5m above Ordnance Datum, and currently has a 4.8 – 5m high sea wall and gully to provide protection from high sea levels and surges [4].

- Any further measures necessary to prevent flooding of the site during the C&M period, such as improvements to the flood defences will be identified through the Periodic Safety Review. Furthermore, the rise in sea level during the C&M period will be gradual, allowing the advance planning of any necessary mitigation measures.

1. DEFRA (2010) Nitrate Vulnerable Zones in England
2. Magnox Ltd. (2011) Bradwell Site IWS
3. IPCC (2007) Projections of Future Change in Climate, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/spmsspm-projections-of.html
4. Gorman W. (2008) Bradwell Re-baseline (Post Defuelling) Safety Case – External Hazards Assessment, BRAD/DEC/REP/058

Figure 1: Statutorily Designated Areas in the Vicinity of Bradwell Site