Permit under the Environmental Permitting (England & Wales) Regulations 2016

We have decided to grant the variation for the Bradwell site discharges permit operated by Magnox Limited.

The Permit Number is:	PR2TS/E10760C
The Applicant / Operator is:	Magnox Limited
The Installation is located at:	Former power station site, Bradwell-on-Sea Essex

We consider in reaching that decision we have taken into account all relevant considerations and legal requirements and that the permit will ensure that the appropriate level of environmental protection is provided.

What this document is about

This document explains how we have considered the Application, and why we have included the specific conditions in the Permit we are issuing to the Applicant. It is our record of our decision-making process, to show how we have taken into account all relevant factors in reaching our position. It is an amended version of the draft decision document which we publicised for consultation on 20 October 2016.

The amendments are as follows;-

(i) we have removed all references to 'minded to' decisions and 'drafts' so that the document represents the final version;

(ii) we have added a brief non-technical summary of the Application;

(iii) we have amended the sections referring to the disinfection of the treated sewage effluent discharge to take account of the fact that the Applicant has installed and are using disinfection facilities ahead of the requirements of our published 'minded to' decision document.

(iv) we have added an extra section (Annex 1b below) to outline the issues raised by respondents to our 'minded to' consultation process and how we have taken these into account in our decision.

Non-technical summary

Background

The Application is to vary a pre-existing permit (the "previous permit") for the discharge of a mixture of effluents in a large (up to 504,900 m3/day) carrier flow of abstracted seawater to the Blackwater Estuary. The mixed effluents include a relatively small (up to 45 m3/day) volume of secondary treated sewage effluent and two types of treated site drainage of lesser volumes. The site drainages are treated to remove traces of heavy metals which have been leached out of debris lying in voids on the site. One of the site drainage effluents contains residual traces of radionuclides because it is from rainfall falling on areas that formerly housed nuclear facilities.

The variation has been prompted by a survey that shows that the existing large outlet for the discharge is becoming blocked with silt. Because there is an ongoing need to drain the site to prevent flooding the Applicant has built a new outlet structure for this purpose. To avoid damaging the estuary bed the Applicant has built a much smaller structure on top of the old one which means that discharges have to be pumped and there is no need (or capacity) for large carrier flows. Due to other changes of infrastructure the (low level) radioactive site drainage effluent will have to be discharged separately from the others when the new outlet needs to be used. It will be a manually controlled discharge made only around the high waters of ebbing tides. The remaining effluents will collect in a large pump sump, along with any clean site drainage, and be pumped automatically into the estuary when triggered by float switches.

These changes will affect the polluting potential of the individual effluents within the current discharge and the risks they pose to the receiving environment because, although there will be no increases to the polluting load, the way it is diluted and dispersed in the estuary will change.

The main body of this document gives greater detail and explains how we have assessed the environmental risks associated with these changes. We have assessed all pollutants in the effluents with the exception of the residual radionuclides. The Applicant has a separate permit (EPR/ZP3493SQ) covering this aspect (as well as radioactive aspects of the treated FED waste effluent discharges – see below). We set our consideration of the radioactive aspects of the above changes in our decision document for this separate application.

The Applicant has also made a third application, to vary their permit (EPR/DP3127XB) for the non-radioactive polluting components of the treated FED waste effluent (mainly metals and nitrates) to allow the use of the new outlet and to extend a time limit for this activity. We set out our consideration of these aspects of the Applicant's proposals in our decision document for this separate application.

We have determined all three applications at the same time but, because the permits cover two different regulatory regimes and there are different types of effluent involved, we have produced three separate decision documents. The decision documents for the other two applications are published on the same date as this document (14 March 2017).

Key Issues

The key issue in this case is whether the proposed changes to the existing discharge regime pose a threat to any receptors of the receiving environment. By receptors we mean all the aquatic flora and fauna that inhabit the Blackwater Estuary including all the designated species of the numerous conservation sites within it and around it (including those of the Blackwater, Crouch, Roach and Colne Estuary Marine Conservation Zone). It also includes the commercial uses of the waterbody and human health risks.

The changes that could increase the risks to receptors are the removal of pre-dilution for the effluents before they are discharged into the estuary and the changes in the dispersion characteristics of the effluents within the estuary. However these risks are mitigated by the facts that, (i) the individual effluents are all small in relation to the range of flows within the estuary at the point of discharge and (ii) the concentrations of pollutants that they contain are also relatively low,

The result of these two factors is that there is a very limited zone within the estuary around the outlet that any of the effluents can adversely affect before dilution reduces the concentration of any pollutants to safe levels. We refer to this zone as the ‘mixing zone’. To judge what concentrations of pollutants are ‘safe’ we compared them to a range of water quality standards some of which are statutory. Beyond the mixing zone, if these water quality standards are met, we are confident that there will be no harm to any receptors.

In this case our assessment used a 100 metre mixing zone because this criteria had been established during the determination for the previous permit for the treated FED effluent discharge. Due to the limited size of this zone we consider that any temporary adverse effects within it are insignificant in the context of the wider estuary.

Our determination therefore focused on the question; is there enough dilution within the 100 metre mixing zone to reduce the pollutants in the different effluents to safe levels by its edge in all the possible circumstances of the changed discharge regime?

Our conclusion is that there is sufficient dilution and therefore that the permit variation may be granted. The sections below explain in detail how we reached this conclusion.

Preliminary information and use of terms

We gave the application the reference number PR2TS/E10760C/V003. We refer to the application as “the **Application**” in this document in order to be consistent.

The number we propose to give the permit is PR2TS/E10760C. We refer to the proposed permit as “the **Permit**” in this document.

The Application was duly made on 5/8/2015.

The Applicant is Magnox Ltd. We refer to Magnox Ltd as “the **Applicant**” in this document although in some place where appropriate we use the term ‘Operator’.

The Applicant’s **discharge** is located at National Grid Reference TL 93580 09640. We refer to this as “the water discharge activity” in this document.

Please note that there are two other applications which were made at the same time for variations to two other permits that the Applicant holds for discharges from the Bradwell site. One of these is an application to vary permit EPR/DP3127XB which is for discharge of treated FED (fuel element debris) effluent and the other is an application to vary permit EPR/ZP3493SQ which allows the Operator to receive and dispose of radioactive waste in carrying out specific radioactive substances activities on the site. EPR/ZP3493SQ has conditions that control the release of the radioactive elements of the discharge of treated FED effluent and those of one of the effluent streams in the permit outlined here. There are separate decision documents (DD’s) explaining how we have determined the applications for variations to EPR/ZP3493SQ and EPR/DP3127XB. This document and the DD for EPR/DP3127XB only address the potentially polluting components of the discharges from the site that are non-radioactive because this is what they can control. Although there are links between the three permits and we have determined the applications at the same time we have produced 3 DD’s for the sake of clarity and because there are two different regulatory regimes involved.

How this document is structured

<u>This document is split into the following sections:</u>

Glossary of acronyms used in this document

AA		Annual Average
DD		Decision document
EMS		Environmental Management System
EPR		Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154)
EQS(s)		Environmental Quality Standard
MAC(s)		Maximum Allowable Concentration
MCZ(s)		Marine Conservation Zone
SAC(s)		Special Area(s) of Conservation
SPA(s)		Special Protection Area(s)
SSSI(s)		Site(s) of Special Scientific Interest
STP		Sewage Treatment Plant
WFD		Water Framework Directive (Directive 2000/60/EC)

1 Our decision

We are granting the Application and issuing a varied permit (the Permit) to the Applicant. This will allow it to discharge, subject to the conditions in the Permit.

We consider that, in reaching that decision, we have taken into account all relevant considerations and legal requirements and that the Permit will ensure that a high level of protection is provided for the environment and human health.

The draft Permit contains standard conditions that are common to the existing permit and some bespoke conditions relating to the changes applied for. This document includes an explanation of the bespoke conditions.

2 How we reached our decision

2.1 Receipt of Application

The Application was duly made on 5 August 2015. This means we considered it was in the correct form and contained sufficient information for us to begin our determination but not that it necessarily contained all the information we would need to complete that determination.

The Applicant made no claim for commercial confidentiality. We have not received any information in relation to the Application that appears to be confidential in relation to any party.

2.2 Consultation on the Application

Our initial consultation followed our internal guidelines for variations to an existing Permit. We advertised the Application on the Gov.UK website on 11 August 2015 and invited people to make representations by 18 September 2015. The full Application documents were made available to view on the Environment Public Register at our offices in Ipswich (Iceni House, Cobham Road, Ipswich 1P3 9JD). We also notified the statutory bodies indicated by our internal guidance. That is, Maldon District Council and Kent and Essex Inshore Fisheries and Conservation Authority.

In recognition of the public interest in the Bradwell site we exceeded our guidelines by directly notifying some individuals and organisations in the area. We contacted them by email on the 6 August 2015. Our email gave notification of the Application and another application to vary the permit EPR/DP312XB which is for a discharge from an abatement plant which treats effluent from the Fuel Element Debris (FED) operation on site which had been made virtually simultaneously. Our email gave notification of the Application and the application to vary the FED permit. The email also explained that the applications and supporting documents could be downloaded from a weblink (https://ea.sharefile.com/d-s9822215ebc94f5a9) and that there were 28 days for them to make any representations to us about the applications. This period was later extended by 15 days.

Due to the level of interest in the applications, and the large number of representations we subsequently received, we took the decision to run a second public consultation exercise when we had reached our draft decision also referred to as a ‘minded to’ decision. A draft decision document and draft Permit were published on 20 October 2016 on an internet sharefile together with the Application and supporting documents and further relevant information received from the Applicant post-application. The location of the sharefile was advertised in two local newspapers and we also emailed statutory consultees and all the interested parties known to us from previous consultations and community liaison. The initial end date for consultation responses was 17 November 2016 but this was subsequently extended until 15 December 2016 at the request of some respondents. It was necessary later when the sharefile expired to re-publish all the consultation documents on the Gov.UK website.

This process is in accordance with the EPR, our statutory Public Participation Statement and our own Regulatory Guidance Series Note 6 for Determinations involving Sites of High Public Interest. We consider that this process satisfies, and frequently goes beyond the requirements of the Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.

We have also taken into account our obligations under the Local Democracy, Economic Development and Construction Act 2009 (particularly Section 23). This requires us, where we consider it appropriate, to take such steps as we consider appropriate to secure the involvement of representatives of interested persons in the exercise of our functions, by providing them with information, consulting them or involving them in any other way. In this case, our consultation already satisfies the Act’s requirements.

In addition to the above, in order to satisfy the requirements of the Habitats Directive, we also sent letters to certain bodies to ascertain if they were aware of any existing, or new, plans, permissions or projects that might have the potential for any ‘in combination’ effects on the receiving environment with the treated FED effluent discharge and the other discharges from the site which are controlled by the permit EPR/DP3127XB.

Letters to the following bodies were sent on the 21 October 2015; Maldon DC, Essex County Council, Brightlingsea Harbour Office, the Marine Management Organisation, Kent and Essex IFCA and Anglian Water. The only reply we received was from Anglian Water. They reported that there were no plans or projects to take into account and made no other comment.

Following the second consultation exercise we received a large number of responses to the ‘minded to’ consultation, some of which were extensive and very detailed although the majority of comments related to the other two

Applications for variations to the permits EPR/DP3127XB and EPR/ZP3493SQ. We have taken time to consider any new, relevant comments made from this exercise and we have taken them into account in our final decision. In Annex 1b below we have summarised the issues raised and explained how these are taken into account in our decision.

2.3 Requests for further information

Although we were able to consider the Application duly made, we did in fact need more information in order to determine it, and made several requests for further information and clarification. A copy of all these have been placed on the Gov.UK website mentioned above.

3 The legal framework

The Permit is granted under regulation 20 of the EPR. The environmental permitting regime is a legal vehicle which delivers most of the relevant legal requirements for activities falling within its scope. In particular the regulated facility is a water discharge activity within the meaning of the EPR.

We address some of the major legal requirements directly where relevant in the body of this document. Other requirements are covered in a section towards the end of this document.

We consider that, by issuing the Permit we ensure that the proposed discharge will comply with all relevant legal requirements and that a high level of protection will be delivered for the environment and human health.

4 The Discharges

4.1. The permitted activities

The discharges are subject to the EPR because it falls within section 3 (a) (iii) of Schedule 21 to the EPR (as ‘trade effluent or sewage effluent’) so is within the definition of a ‘water discharge activity’.

4.2 Description of the discharges and the background to the Application

The Applicant wishes to vary the previous permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m^3) a day of mixed effluents from the former Bradwell Nuclear Power Station at Bradwell on Sea, Essex to the Blackwater Estuary through an outlet at National Grid Reference TL 99650 09150. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater. This carrier flow facilitates a positive flow out of a large outlet pipe onto the estuary bed. The previous permit is a variation which was issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by the permit EPR/ZP3493SQ mentioned above.

In recent years the existing large outlet pipe has been silting up and a survey has revealed that it may become unusable in the near future. The Applicant has therefore constructed a new outlet structure on top of the old outlet because there is an ongoing need to drain the site to avoid flooding. Desilting the existing outlet, or building one of a similar size, would have risked damaging the local environment from mobilised silt. The new outlet structure consists of four small pipes. Three of these are just above the old outlet and the fourth is higher in the water column just below the level of the lowest tide.

The Applicant will continue discharging out of the existing outlet but when it becomes necessary in future, it will cease doing so and discharge the effluents out of the new outlet structure. It will carry out the new discharge by pumping, which will eliminate the need for using large volumes of seawater for flushing. However this will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the treated radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The radioactive site drainage will be pumped through the higher outlet pipe and the remaining effluents in admixture will be pumped through the lower pipes.

The requested changes to the Permit are therefore:-

- to use the new outlets when it becomes necessary
- to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow
- to have two discharges instead of one completely mixed effluent

The two discharges will be:-

1. A mixture of

    (i) treated non-radioactive site drainage and void waters

    (ii) secondary treated sewage effluent

    (iii) trade effluent from water treatment and

(iv) clean uncontaminated site drainage

2. Treated radioactive site drainage

For the remainder of this document we will refer to discharge 1 above as the 'mixed effluents' discharge and discharge 2 as 'treated radioactive site drainage'.

4.3. Volume and contents of the discharges

4.3.1 Mixed effluents discharge

Volume

Because the mixed effluents discharge contains an element of clean uncontaminated site drainage from rainfall runoff, the volume discharged on any one day could vary greatly. This will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents in the mixed effluents discharge drain to a common chamber. Pumps in this chamber are automatically activated by a float switch at a certain water level and will discharge 130 m^3 until there is further ingress to trigger any further pumping. If there is no further ingress on any particular day (for example because of dry weather) there will be no further discharge. So 130 m^3 is the minimum daily volume which could occur on any one day in a period of dry weather. The maximum possible discharge on any one day (for example during wet weather) is 50,000 m^3 because this is the maximum capacity of the pumps.

The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m^3 can be discharged in twenty minutes and, because pumping is automatic and not manually controlled, the discharges can occur on any tidal state.

The breakdown of the individual maximum daily volumes of the different effluents within the discharge are:-

(i) Treated non-radioactive site drainage – Maximum 20 m^3 a day based on the maximum capacity of the treatment plant

(ii) Secondary treated sewage effluent – Maximum 45 m^3 a day based on the maximum capacity of the treatment plant

(iii) Water treatment effluent – Maximum 5 m^3 based on the maximum capacity of the treatment plant

(iv) Clean uncontaminated site drainage – rainfall dependent volume

We consider the contents of each of these elements of the mixed effluents discharge in turn below.

Box 1: Discharge volumes

We indicate in this document the discharge volumes of various effluents as cubic metres.

A cubic metre is one thousand litres so 130 m^3 is 130,000 litres. To put these figures into perspective, the average volume of the Blackwater estuary alone is estimated to be 106,300,000 m^3. Consequently, there is nearly one million times potential dilution available for the minimum discharge volume. That minimum discharge volume would also be the state in which the concentration of any pollutants within the discharge will be at their highest (as explained below). When the discharge is any higher than 130 m^3, because of rainfall runoff, the pollutant concentrations within it will be diluted by that rainfall.

It should be noted that the average volume figure of the Blackwater estuary given above is included to allow a simplistic comparison. It has not been used in our assessment of potential impacts, which relies on hydrodynamic modelling techniques.

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(i) Non-radioactive site drainage

The areas of the site drained to produce the mixed effluents discharge include some voids which contain demolition debris, including concrete and metals. Over time rainfall onto crushed concrete creates an alkaline liquid (up to pH 12) which leaches traces of metals from the debris. As stated above, this effluent will be limited to 20 m^3 (due to the capacity of the treatment plant referred to below).

This contaminated runoff is treated in a 'siltbuster' treatment plant which neutralises the pH. There is also filtration and settlement within the plant. The primary purpose of this treatment is to reduce the concentrations of suspended solids in the site drainage but these processes will reduce the concentrations of metals also to some extent. The minimum dilution the 20 m^3 of effluent will receive in the other effluents before being discharged into the Blackwater Estuary is 5.5:1 based on the 130 m^3 minimum total discharge. But in any period of wet weather the dilution will very much higher.

Table 1 below illustrates the maximum concentrations of the various metals the effluent could contain in the minimum 130 m^3 discharge. As such it represents the worst case scenario. In or after periods of rainfall the metals concentrations will be lower proportionate to the discharge volumes. Table 1 also shows the relevant environmental quality standards (EQS's) for each metal. The units in the table are micrograms per litre (µg/l). These are equivalent to one part in one thousand million, that is, one part per billion. These EQS's are important for judging whether the concentrations of metals in the effluent have the potential to have any adverse affect in the receiving environment.

Table 1 - Metals concentrations in mixed effluents discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (µg/l)	EQS MAC (µg/l)	Average concentration in effluent after dilution in other effluents (µg/l)	EQS AA (µg/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	10.9
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

The effluent will be in the in the pH range of 6 to 9 and of ambient temperature.

(ii) Secondary treated sewage effluent

The secondary treated sewage effluent will be up to 45 m^3 a day. This effluent is from the sewage treatment plant (STP) which serves the various toilet and washing facilities for the on site workforce. The volume quoted in the Application is 30 m^3 but, after we questioned the maximum capacity of the STP, the Applicant reported that it is 45 m^3. This is suitable for the size of the current 450 workforce on site. The industry standard for industrial sites is to allow 50 to 100 litres per head, per day, depending on the provision of such things as canteen facilities. In this case 45 m^3 is probably an overestimate, especially as staff numbers decrease, but we have used this figure in our assessment as a worst case scenario. Over the next few years as the site activities decline the workforce will diminish and the daily volume will decrease. When the site is fully decommissioned and only security staff are left the STP will be removed and there will be no discharge.

Because the secondary treated sewage effluent is domestic-only sewage, with no inputs of pollutants from any trade processes, the effluent does not contain any hazardous substances. The STP provides standard levels of treatment which can achieve emission limits of 20 milligrams per litre (mg/l) (i.e. one part per million) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia.

(iii) Water treatment effluent

This effluent is the result of the treatment of tap water on site in a reverse osmosis plant to make it suitably pure to be used in the other treatment plants which remove metals. The resulting 5 m^3 of effluent a day does not contain any polluting substances in significant concentrations and the only way this component of the discharge influences the polluting potential of the mixed effluents discharge is to dilute the other components in it.

(iv) Clean site drainage

This is runoff from the clean areas of the site and so does not contain any pollutants. Its volume will be rainfall dependant. It could contain small amounts of suspended solids but these will settle out in the retention chamber. As with the water treatment effluent, the only way this component of the discharge can influence the polluting potential of the mixed effluents discharge is to dilute the other components in it.

4.3.2 Treated radioactive site drainage

Volume

The maximum daily volume of treated radioactive site drainage is 30 m^3 per day. This is because 30 m^3 is the maximum capacity of the treatment plant and a retention chamber. Discharges from the retention chamber will be made by pumps which are manually controlled to ensure correct timing. Discharges will be made over one hour at a maximum rate of 8 litres a second and only on one ebbing tide per day between 1 and 2.5 hours after high water.

The new outlet is a 180 mm pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. This configuration is designed to achieve the maximum dispersion and dilution characteristics. The same outlet will also be used for the treated FED effluent discharge which is outlined in a separate DD for the variation to the permit EPR/DP3127XB. If the two discharges need to be made on the same day they will be made on opposite ebbing tides. However, the discharge under this Permit is rainfall dependant so intermittent and, in practice, the treated FED effluent is also likely to be intermittent. Consequently, it is unlikely that there will be much occasion for the two discharges to occur on the same day.

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The source of the treated radioactive site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. As with the non-radioactive site drainage, when rainfall mixes with the crushed concrete it can become strongly alkaline, dissolving metals in the demolition waste. The resulting runoff and void waters can therefore be high in pH and contain suspended solids and residual traces of metals.

This contaminated drainage is collected and treated in an 'aqueous abatement plant'. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 2 below outlines the metals that have been detected in the treated radioactive site drainage effluent, together with their maximum concentrations and a comparison with relevant EQS’s.

Table 2 - Metals concentrations in the treated radioactive site drainage effluent compared to EQS’s

Substance	EQS AA (µg/l)	EQS MAC (µg/l)	Maximum Concentration in Effluent from supporting docs (µg/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	10.9	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

The effluent will be in the in the pH range of 6 to 9 and of ambient temperature.

5. Key issues in the determination

The key issues arising during this determination are outlined below together with a brief explanation of how we approached the task of taking them into account to reach our final decision.

5.1 Protection of all the sensitive receptors of the receiving environment

The primary issue in this determination is common to all determinations, that is, whether we can grant a permit with conditions that will ensure that the discharge will not result in unacceptable risk to sensitive receptors of the receiving environment.

By receptors in this case we mean in particular:

(i) all aquatic flora and fauna

(ii) the specific species and features of the sites designated in UK, European and international habitats legislation i.e. SSSI’s, SAC’s SPA’s, Ramsar sites and MCZs

(iii) commercial uses of the receiving waters i.e. fisheries and shell fisheries

(iv) humans experiencing direct or indirect exposure to the receiving waters via work or recreational activities i.e. fishing, sailing, swimming, beach activities etc.

5.2 Marine Conservation Zone – Blackwater, Crouch, Roach and Colne Estuaries MCZ

In addition to protection of sensitive receptors generally (including protected habitat sites), this determination has considered the potential impact on the above MCZ. The MCZ was designated on 21 November 2013, just over a week before the previous permit was issued.

Since that time Natural England have been formulating very detailed advice for the protection of its designated features which include some water quality standards which are drawn from the Water Framework Directive (Directive 2000/60/EC) (WFD). In this determination we have addressed the conservation objectives and water quality standards outlined in the advice documents that Natural England have provided to date.

Natural England have also produced similar, conservation advice for the protection of the Essex Estuaries SAC and we have taken this into account also.

6. How we addressed key issues and made our decision

We set out in sections 6.1 to 6.13 below how we have addressed the key issues noted in section 5 above. We then set out in section 6.14 our conclusions and the implications for the Permit. We set out in section 7 below how these have been incorporated into permit conditions where necessary.

6.1 Environmental impact assessments

Because our focus is on environmental protection the primary basis for our determination has been our analysis of the Applicant's assessment of the environmental impacts of the changes it is proposing. The main elements of this analysis have been:-

(i) How the impact assessment compares with the Agency's guidelines for undertaking them

(ii) Whether the assessment incorporated the correct water quality standards to be met in the receiving waters.

There are two key concepts (mixing zones and water quality standards) which also underpin the impact assessment and our analysis of it.

6.2 Acceptable mixing zones and water quality standards

Assessing whether the discharge (through either outlet) has the potential to harm any of the receptors the receiving environment is seemingly a complex task. The receptors are of different types with different sensitivities to different pollutants within the discharge and they are in many different, widespread locations and some are obviously mobile. However the task is simplified by the following factors:-

- The volumes of the component treated effluents are very small in relation to the volume of the receiving estuary and wider coastal waters, so their potential zone for adverse effects on receptors is limited.

- There are a range of water quality standards established by European and UK legislation on the basis that they will ensure protection of aquatic organisms and their habitats. If these are met outside the limited zone of influence we can be confident that receptors will not be harmed beyond that zone.

- A further indication of protecting receptors is maintenance of existing background quality of the receiving waters. If the background quality does not significantly change outside the limited zone of influence we can be confident that receptors will not be harmed beyond that zone.

A more formal term for the 'limited zone of adverse influence' mentioned above is a 'mixing zone'. Mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels of the appropriate water quality standards for the receiving waters. Hence mixing zones are permissible, within which dilution can reduce contaminants to below target levels before they spread any further. Member states may allow operators to employ mixing zones in accordance with the Environmental Quality Standard Directive (Directive 2008/105/EC) (EQS Directive). Water quality standards may be exceeded within this mixing zone but, so long as they are not exceeded beyond it, our water quality duties will be met. Further, because of the limited extent of the mixing zone, we are confident that any impacts upon receptors within it will be insignificant in the context of the overall estuary.

In accordance with the EQS Directive, member states have established criteria for such zones. These criteria are incorporated into guidance that the Agency uses and which is published on the gov.uk website. The criteria are aimed at spatially minimising mixing zones as far a possible within the receiving waters. The Agency is the competent authority to determine what size of zone is acceptable in each case but, when the discharge is in the vicinity of a designated conservation site we have to have Natural England's agreement.

In this case our assessment uses a 100 metre mixing zone as this has been established as part of the assessment criteria when the previous permit for the treated FED effluent discharge was determined.

The following sections will outline;

- what water quality standards are appropriate to protect the receptors of the receiving environment (section 6.3 to 6.10);
- how the Applicant's impact assessment seeks to establish that they will be met and how it compares with the Agency's guidelines (section 6.11 and 6.12);
- our analysis of the assessment together with some additional work of our own (section 6.13); and
- our conclusions as to what permit conditions will protect the receptors of the receiving environment for the two separate discharges from the site (section 6.14).

6.3 Water quality standards and limiting deterioration

There are a range of water quality standards applicable to estuarial and coastal waters but we have focused on those for pollutants that the effluents from the Bradwell site contain in concentrations that could have significant effects on the receiving waters. These standards apply to the residual metals in the treated radioactive site drainage and non-radioactive site drainage effluents (as set out in Tables 1 and 2 above). In addition, pathogen standards are applicable to the microbiological pollutants contained in the secondary treated sewage effluent.

The fundamental purpose of the standards for microbiological pollutants are to protect human health either from the direct exposure to the receiving waters from bathing/swimming etc or indirectly from the consumption of shellfish harvested from the waters. Microbiological standards are numeric standards based on the number of specific species of microorganisms detectable in samples of defined amounts of either surface water (for bathing waters) or shellfish flesh (for shellfish waters). If the number of the specific 'indicator' microorganisms in the sample exceed a fixed amount the standard is failed. Further details of these standards are given in sections 6.7 and 6.9 below.

The standards for metals are in the form of specific concentrations for each metal, calculated from long term scientific research to be protective of aquatic organisms. These standards are referred to as environmental quality standards (EQS's). Because the mixing zone is limited in size, any effects within it on aquatic organisms are insignificant in the context of the overall estuary and, by ensuring that EQS's are not exceeded outside the mixing zone, we can be confident of no significant adverse effects being caused to any receptors.

6.4 EQS's (environmental quality standards)

EQS's are the key water quality standard for assessing whether the concentrations of various heavy metals that the treated radioactive site drainage and non-radioactive site drainage effluents contain could have any adverse effect on the receptors of the receiving waterbodies. They are based on research into the toxicity of substances to all aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at a level designed to prevent long term chronic effects of exposure to the metals concerned. Maximum allowable concentrations (MAC) are set to prevent short term acute toxic effects from exposure to the relevant metals. Both AA and MAC EQS's are calculated by applying safety factors of at least 10 (but sometimes up to 1000) to the lowest known toxicity concentration of substances. This is to make sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.

Because of the way that EQS's are established to avoid chronic and acute adverse effects, we can be confident that if the relevant EQS's are met in the estuary waters outside the 100 metre mixing zone, no harm would be caused to any aquatic organisms or their habitat from the discharge beyond that zone (due to its size, potential for harm inside the zone also being insignificant).

The EQS's we have used in our determination are the most up to date. They are taken from the EQS Directive (as amended by Directive 2013/39/EU) and the EQS's for pollutants set out in Annexe 8 of the WFD. These are implemented in England through the "Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015". The relevant EQS's for each metal contained in significant concentrations in the mixed drainage effluent and the treated radioactive site drainage are shown in Tables 1 and 2 above respectively.

All the EQS's, whatever their source, form part of the WFD water quality standards for the protection of all surface waters which are explained in section 6.5 below.

6.5 Water Framework Directive (WFD) standards

The WFD integrates previously fragmented European legislation for the protection of the water environment into one comprehensive framework. This framework includes a set of standards for water quality in rivers, lakes, estuaries and coastal waters. These are devised from the best available scientific knowledge for the protection of aquatic organism and their habitats. By ensuring that these standards are met when making permitting decisions we can be confident that we are protecting all the receptors of the receiving environment.

WFD regime

Under the WFD regime all surface waters within the UK have been divided into river basin catchments and subdivided into individual waterbodies for the purposes of classifying and monitoring their water quality and overall ecological health and to enable long term planning and regulatory action to maintain or improve this.

Classification is assessed based on a set of standards made up of chemical and ecological components. In estuarine waterbodies these standards include chemical parameters such as EQS's for metals, physiochemical parameters such as dissolved inorganic nitrogen (DIN) and biological standards such as the presence and extent of unwanted growths of macroalgae (seaweed) which indicate eutrophication effects from excessive nutrients.

Based on whether all the standards are met, waterbodies are classified into five categories of 'status':- High, Good, Moderate, Poor or Bad. The overall status of the waterbody corresponds to the level of the lowest category for any individual parameter.

In this case the standards that are relevant to our permitting decisions are the chemical standards in the form of EQS's for the individual metals in the mixed drainage effluent and the treated radioactive site drainage. These discharges do not contain any other pollutants in sufficient concentrations to have any significant effect on any other of the other WFD standards.

WFD waterbodies were first designated in 2009 within the larger units of River Basins that they form the integral parts of. Their individual classifications were based on the Agency's historical water quality monitoring data for them. At this time River Basin Management Plans (RBMP) were devised so that any actions to improve waterbodies would be in the context of the whole river basin and not isolated and piecemeal. Every six years there are major assessments of the quality and status of waterbodies and decisions are made about the feasibility of including actions to achieve the long term objectives for the RBMP in the next six year cycle. Cycle 1 began in 2009 and ended in 2015. Currently we are in Cycle 2 which will end in 2021. So the next date for RMBP objectives to be met is 2021.

The WFD classification situation for the waterbodies in the vicinity of the discharge from the Bradwell site is not straightforward. In the transition between the cycles (and since the existing permit was issues in November 2013) the Blackwater area waterbodies have been re-configured and re-classified within the RBMP. Figure 1 below illustrates the changes. It shows (by underlying horizontal shading) that in Cycle 1 the inner section of the Blackwater estuary and the Colne estuary were classified as one waterbody named the 'Blackwater and Colne' but that in Cycle 2 they were separated into two distinct waterbodies as indicated by the different colours on top of the horizontal shading. These waterbodies are labelled as 'transitional' because they are between rivers and the open sea. The adjacent 'Blackwater Outer' and 'Essex' waterbodies are known as 'coastal' waterbodies. These have not been changed within the RBMP. It can be seen from the map that the permitted discharge is into what used to be the 'Blackwater and Colne' and is now the 'Blackwater'. All waterbodies have an identification number within the RBMP. The 'Blackwater and Colne' was GB520503713900. The 'Blackwater' is now GB520503714000 and the 'Colne' is GB520503713800. The 'Blackwater Outer' is GB650503200000 and the 'Essex' is GB65050352001.

At the beginning of Cycle 1 the Blackwater and Colne waterbody was classified as overall 'Moderate' status and the Blackwater Outer and Essex waterbodies as overall 'Good'. But in Cycle 2 all the waterbodies in the Blackwater area were re-classified as overall 'Moderate status. They are all prevented from attaining overall 'Good' status because they do not meet the AA DIN concentration standard which forms part of the physiochemical component.

However all the waterbodies in the Blackwater area achieve 'Good' standard for metals. There are no failures of the relevant EQS's for metals within any of them. The long term objective for these waterbodies for metals at the end of Cycle 2 in 2021 and the end of Cycle 3 in 2027 is therefore that 'Good' status be maintained.

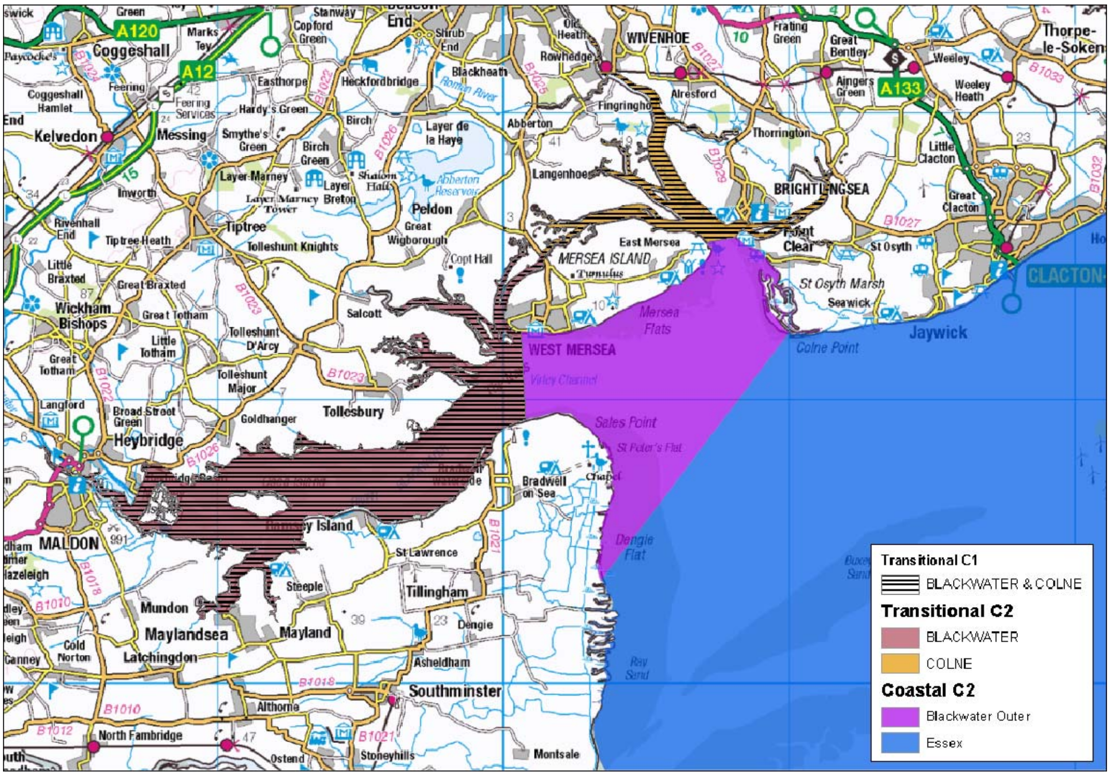


Figure 1 Map of WFD waterbodies in the Blackwater area showing changes between Cycle 1 and Cycle 2

Targets derived from WFD standards

The WFD standards for the metals contained in the treated radioactive site drainage and non-radioactive site drainage is that the relevant EQS's have to be met. If this is achieved, the receiving water body will maintain its current 'Good' status for the relevant chemical elements.

In this case therefore, our duty to secure compliance with the requirements of WFD requires that we ensure that the discharges controlled by the Permit do not lead to a breach outside the mixing zone of any EQS for the metals they contain (so does not allow any of the relevant quality elements to deteriorate from ‘Good’ status).

There are no specific standards for the physiochemical parameters of temperature and pH in estuarial waters, which the discharge could influence. However, the Agency works to guideline standards of achieving pH 7 to 9 in the receiving waters and limiting any increase in ambient temperatures to 2 degrees Celsius.

If these targets are achieved outside the mixing zone we can be confident that we will have secured that the Applicant complies with the requirements of WFD and that by doing so the existing water quality of the receiving waterbodies will be maintained and receptors protected.

6.6 Habitats

There are a large number of designated conservation sites in the vicinity of the discharge which have various levels of statutory protection. They are:

- Blackwater Estuary SSSI
- Colne Estuary SSSI
- Crouch and Roach Estuaries SSSI
- Dengie SSSI
- Foulness SSSI
- Blackwater Estuary (Mid Essex Coast Phase 4) SPA and Ramsar site
- Colne Estuary (MID Essex Coast Phase 2) SPA and Ramsar site,
- Crouch and Roach Estuaries (MID Essex Coast Phase 3) SPA and Ramsar site
- Dengie (Mid Essex Coast Phase 1) SPA and Ramsar site
- Foulness (Mid Essex Coast Phase 5) SPA and Ramsar site
- Outer Thames SPA,
- Essex Estuaries SAC and
- Blackwater, Colne, Crouch and Roach Estuaries MCZ

There are no specific water quality targets for the protection of the designated features and habitats for the majority of these sites. However, we are confident that if the discharge does not cause a breach of the WFD water quality standards described above there would be no significant adverse effects upon them if we granted a permit. In fact Natural England have incorporated some WFD standards in its conservation advice for the protection of the Blackwater, Colne, Crouch and Roach Estuaries MCZ and the Essex Estuaries SAC. These are the only sites that have specific water quality targets but, because these sites are amalgams of their associated SSSI’s, the same water quality standards apply within most of the protected areas above by default.

Examples of the water quality targets that are present in Natural England's conservation advice for the MCZ and Essex Estuaries SAC that are relevant to this Application are:-

- Water quality contaminants - Reduce aqueous contaminants to levels equating to Food Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels.
- Maintain the natural physio-chemical properties of the water (pH and temperature).

The full details of how we have assessed the potential impact on the all the above habitats sites of the treated radioactive site drainage and mixed effluents discharge is outlined in the consultation documents we submitted to Natural England which are given in Annexe 2 to this document. The basic principles of our habitats assessments are the same as outlined here because they apply to the protection of all receptors. Because of the number of sites there are a large number of documents and because the same principles apply there is repetition of information across them. The documents for the Habitats sites of the Blackwater Estuary contain all the key information.

6.7 <u>Protection of shellfish</u>

Before the advent of the WFD, shellfish waters were protected under the Shellfish Waters Directive (Directive 79/923/EEC as amended). It set physical, chemical and microbiological water quality requirements that designated shellfish waters had to comply with. This directive was repealed in 2013 and for most purposes its requirements were subsumed into WFD, which provides the same level of protection to shellfish waters via compliance with its physiochemical, chemical and biological standards.

Under regulation 7A of the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 specific shellfish waters are designated as 'protected areas' by inclusion in a list which is subject to amendments. The Blackwater Estuary has been included by amendment in the protected area list. Environmental objectives are set to achieve water quality objectives necessary or desirable to improve or protect these protected areas in order to support shellfish life and growth and to contribute to the high quality of shellfish products suitable for human consumption.

The implications of this for the discharges from the Bradwell site are that:

(a) the treated radioactive site drainage and mixed effluents discharge must not cause a breach of EQS's for the metals they contain in the receiving waters (outside the mixing zone); and

(b) the secondary treated sewage effluent must not breach the relevant microbiological standard. The microbiological standard is defined in sub paragraph 3(2) of the Shellfish Water Protected Areas (England and Wales) Directions 2016 as '300 or fewer colony forming units of Eschericha coli per 100 ml of shellfish flesh and 'intervalvular' fluid'.

6.8 Protection of fish

As with shellfish, before the advent of the WFD certain fisheries were protected by the Freshwater Fisheries Directive (Directive 78/659/EEC) which had some specific water quality targets for designated fisheries. This directive was also repealed in 2013 by WFD which now contains the appropriated standards to ensure the protection of fish species and their habitats. We are therefore confident that if the discharge does not risk a breach of any of the relevant WFD standards in the receiving waterbodies there will be no adverse effect on any commercial or recreational fishing activities within them outside of the 100 metre mixing zone. The relevant WFD standards are the specific EQS's for each of the metals that the discharges from the site are known to contain.

6.9 Protection of bathing waters

The only specific water quality standard that is aimed at protecting human health from the direct exposure to surface waters in the UK is a micro-biological standard which comes from the Bathing Water Regulations 2013. These implement the revised Bathing Waters Directive (2006/7/EC). Under the WFD, designated bathing waters can be classified as 'protected areas' and the micro- biological standard applies within these areas. The only such area in the vicinity of the discharges from the Bradwell site is at West Mersea approximately three kilometres across the Blackwater Estuary from the discharge points.

The relevant standard stipulates three target concentrations for 'Intestinal enterococci' and 'Escherichia coli'. These concentrations correspond to classifications of either 'Sufficient', 'Good' or 'Excellent'. Although 'Sufficient' is the minimum baseline to achieve the directive's goals, the Agency aims to achieve the higher, 'Good' standard. The standard for 'Good' in coastal and transitional waters is that in 100 millilitres of water there must be 200 or less 'colony forming units' (cfu's) of 'Intestinal enterococci' and 500 or less cfu's of 'Escheria coli'.

The distance between the outlets for the discharges from the Bradwell site means that both the current discharges through the existing outlet, and any future discharges from the new outlet above it, would pose no risk to bathers or anyone exposed to the waters there. The dilution in the waters of the estuary between them would negate any pollution. The dispersion pathway (in or out of the estuary depending on the tide) would also mitigate against pollutants in the discharge reaching the protected bathing area.

The main threats to it are the discharges from the major sewage works serving large population centres in the catchment, some of which have disinfection facilities, Currently the West Mersea protected area is passing the bathing water standard.

6.10 Protection of human health

The Agency has a statutory role to protect the environment and human health from all processes and activities it regulates. The only statutory water quality standards for this purpose that pertain to the Blackwater Estuary are those mentioned above which apply to the protected areas of the bathing and shellfish waters.

With regard to the metals within the treated radioactive site drainage and the mixed effluents discharge, a precautionary water quality standard is that the existing background water quality be maintained. If the current work and recreational uses of the waterbodies (involving a range of exposure levels to the water from the full immersion of swimmers to the spraying of people walking on the shore from surf or wind) takes place without any adverse human health impacts, we can be confident that preventing any significant deterioration beyond the very limited mixing zone will not have any human health implications. We can also be confident that, due to its location and very limited size the risk of any adverse effects within the mixing zone are insignificant.

Consequently, the human health water quality targets in the receiving estuary we have used in this case are the pathogen standards for bathing and shellfish waters and the maintenance of the existing background water quality for metals.

6.11 Environment Agency guidance for impact assessments

At the time of the Application there was published guidance for applicants wishing to understand the framework for assessing environmental impact assessments and setting permit limits for sites regulated by the Agency. In this case the relevant document for assessing the potential impacts of the metals traces in the treated radioactive site drainage and the mixed effluents discharge was H1 Annexe D1 ‘Assessment of Hazardous Pollutants within Surface Waters’. This guidance was withdrawn on 1 February 2016 as part of a wider government initiative to streamline regulatory guidance. However, it still accurately reflects the Agency’s approach.

With regard to the microbiological pollutants in the secondary treated sewage effluent component of the mixed effluents discharge there is no equivalent H1 document to guide applicants to produce environmental impact assessments. The main Agency guidance for this field is ‘How to comply with your environmental permit, Additional guidance for: Water Discharge and Groundwater (from point source) Activity Permits’ (EPR 7.01). This explains how to assess what treatment facilities are appropriate to protect receiving waters from a discharge of sewage effluent that the Agency has determined to be a risk to shellfish or bathing waters 'protected areas'. Further details of the contents of these documents are given below.

H1 Annexe D1 – Heavy Metals

This Annexe outlines a sequence of screening tools to assess the significance of the concentrations of the individual hazardous pollutants within discharges. In this context 'hazardous' means that a substance has known toxicities to aquatic organisms and therefore has a specific EQS. If the effluent characteristics meet certain criteria and the concentration of a substance within the discharge screens out at any stage in the sequence it is deemed 'insignificant'. No further assessment is then required and no numeric emission standards are set within permits for substances that are insignificant in H1 terms. If the concentrations in the effluents fail these tests further assessment is required in the form of hydrodynamic modelling. This is necessary to determine if they do have the potential to cause significant polluting effects and whether numeric emission limits are required within permits to prevent this.

The first major test is whether the concentrations of each metal in the effluent is above the appropriate EQS. If the concentrations are lower than EQS they are screened out as insignificant because there is no risk of them breaching the EQS in the receiving waterbody even before they are diluted within it.

If this test is failed the second major test uses a formula devised on the basis of the EQS Directive requirements. It incorporates the effluent flow and pollutant concentrations, the relevant EQS's and the existing background concentrations to determine whether the mixing zone for each substance will be 'allowable'. That is 'allowable' in terms of the guidance on mixing zones referred to in section 6.2 above. If the substances in the effluents pass this test they are deemed to be 'insignificant'. Insignificant means that they do not have the potential to breach any water quality standards or cause significant (more than 10%) deterioration to the existing background concentrations of substances outside a very limited mixing zone. H1 further stipulates that substances that pass this test do not require any further assessment and do not need to be controlled by a numeric emission limit in a permit.

'How to comply with your environmental permit' (EPR 7.01)

The Agency determines whether a discharge poses a risk to a protected bathing or shellfish area based on a calculation of whether the mechanisms that will reduce the concentrations of harmful microorganisms (that are known to be in raw sewage) will be sufficient to meet the appropriate water quality standards in the receiving waters. The relevant mechanisms are; (i) secondary treatment of the sewage, (ii) additional tertiary treatment by Ultra Violet (UV) disinfection, (iii) dilution within the receiving waters between the discharge point and the protected area.

In some cases the combination of secondary treatment and dilution is enough for the appropriate standard to be met but in others there is a need for UV disinfection as well. EPR 7.01 outlines what degree of reduction can be achieved by secondary treatment for the different types of microorganism and how to account for dilution factors. If the combination of secondary treatment and dilution are insufficient to achieve the appropriate reduction figure in each case EPR 7.01 explains how to calculate what UV dosage will achieve the additional reductions needed, so that the appropriate disinfection facilities for this can be sourced.

6.12 The Applicant's environmental impact assessment

In this case the Applicant made no assessment of the risks from the secondary treated sewage effluent component of the mixed effluents discharge to the receiving waters from the change of outlet and the removal of the pre-dilution. Their risk assessment (undertaken by their consultants HR Wallingford Ltd) focused on the metals detected in the treated radioactive site drainage and the treated non-radioactive site drainage effluent element of the mixed effluents discharge (both as outlined in Table 1 and 2 above). HR Wallingford applied the H1 screening tests.

- Treated Radioactive Site Drainage

In this effluent the concentrations of chromium, nickel, copper, zinc, cadmium, lead and mercury are all above the relevant EQS. Consequently, they failed the first major screening test. Iron screened out as being insignificant because its concentration is below EQS.

In the second major H1 test the remaining substances all screened out and were therefore also deemed to be 'insignificant'. None of the metals detected in this effluent therefore required further hydrodynamic modelling.

However HR Wallingford have provided hydrodynamic modelling for this effluent anyway because they had to undertake it for the treated FED effluent discharge from the site controlled by the permit EPR/DP3127XB. The FED effluent discharge shares an outlet with the treated radioactive site drainage and will have very similar discharge arrangements and timing. When the existing outlet silts up the Applicant plans to use the same outlet for both discharges and they will both be discharged on the high waters of ebbing tides. The only differences are that they will be discharged on different ebbing tides (if they need to be discharged on the same day) and that the volumes and durations of discharge are slightly different.

The maximum volume of the treated FED effluent is 10 m^3 lower than the treated radioactive site drainage and it will be discharged over 30 minutes instead of 60 minutes. But, because of the similarities in discharge parameters, the complex dilution and dispersion modelling undertaken HR Wallingford for the FED effluent discharge could also be used to predict dilution factors for the treated radioactive site drainage.

A 100 m mixing zone had been agreed for the treated FED effluent when it was first permitted in 2011. This was the basis for the current application for variation to the FED effluent discharge permit (as explained in the relevant DD). Having accepted this mixing zone for the treated FED effluent discharge we also regard it as being relevant for the treated radioactive site drainage.

The key predictions of this modelling with regard to the treated radioactive site drainage is that it will be diluted by an absolute ‘minimum’ factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made. This is the dilution factor relevant to assessing compliance with the MAC EQS’s for each metal because they are the concentrations that may have a direct toxic effect if organisms are exposed to them for a few hours.

The minimum ‘average’ dilution over the same period is 700:1. The minimum ‘average’ dilution over a 24 hour period is therefore (24 X 700) 16,800:1. This is the dilution factor that it is most relevant to use for the consideration of whether annual average (AA) EQS’s will be met since AA EQS’s protect against adverse effects from the chronic effects of exposure to substances over the very long periods. However using an average dilution factor that relates to a single day is very conservative for an intermittent discharge which will not occur every day because it is rainfall related.

- Mixed effluents discharge

As with the treated radioactive site drainage, HR Wallingford applied the two major H1 screening tests to the metals concentrations of the non radioactive site drainage element of the mixed effluents discharge. In this case all the metals except chromium passed the first test. In other words they screened out as being insignificant because their detected concentrations in the effluent after dilution with the other elements in the mixed effluents discharge are less than their EQS concentrations in each case. So, even without dilution in the receiving waters, they could not cause an EQS failure within them and therefore pose no threat to any receptors.

The average chromium concentration detected in the mixed effluents discharge (3.88 µg/l) is greater than its annual average (AA) EQS (0.6 µg/l). Consequently, it was subject to the second major H1 test. At this stage the chromium also screened out as being ‘insignificant’.

6.13 <u>Our vetting of the impact assessment and our own supplementary work</u>

Our determination has focused on the impact assessment provided by the Applicant to support its Application for changes to the previous permit. We have analysed this by, (i) comparing it the Agency’s guidance for impacts assessment, (ii) checking whether it incorporates the correct water quality targets and (iii) checking whether the modelling on which the assessment is based is fit for purpose.

The potential risks to shellfish and bathing waters from micro-biological contaminants in the mixed effluents discharge was not addressed by the Applicant in its environmental risk assessment. However, we have undertaken our own assessment in line with EPR.7.01 and our internal guidance. Details of our approach are given below for each of the treated radioactive site drainage and the mixed effluents discharge.

Treated Radioactive Site Drainage

We scrutinised the Applicant's screening exercises for this effluent and found that they had followed our H1 guidance although there were some minor mistakes. One of these was the use of some out of date EQS's which have recently been tightened. Having pointed out the discrepancies to HR Wallingford they re-ran the screening tests and the effluent still passed.

In addition Agency specialists scrutinised HR Wallingford's modelling reports. After some questioning for clarification, they agreed that the modelling exercise was valid and its conclusions regarding predicted dilution factors for the effluent are credible.

Table 3 below illustrates how these dilution factors give additional confidence that all the relevant EQS's outside the 100 mixing zone will be met. It shows that 240:1 dilution is more than sufficient to reduce the concentrations of those metals that have MAC EQS's in the effluent to below MAC concentrations. It also shows that 16,800:1 dilution is more than sufficient to allow the AA EQS's in each case to be met.

Table 4 further below compares the maximum concentration of the metals in the effluent with the existing annual average background concentrations of the same metals at an Agency routine sample point in the estuary South East of West Mersea. It also illustrates what dilution factors would be necessary to reduce the metals concentrations in the effluent to background levels. It can be seen that the highest dilution required is 262.5:1 for mercury, so that the 16,800:1 available is much more than adequate. It is clear from these comparisons that the dilution available within the mixing zone is sufficient to prevent the metals concentrations in the treated radioactive site drainage breaching any EQS or causing any significant (i.e > 10%) deterioration in the receiving waters.

This analysis does not take strict account of the background concentrations in the receiving waters but the high dilutions available (especially for the AA EQS's) mean that these are not considered significant. Because the discharge is rainfall related and will be intermittent the use of the 16,000:1 dilution factor is conservative (it assumes a discharge every day).

Table 3 – Dilution required in the mixing zone to meet EQS's

Substance	Maximum Conc in Effluent (µg/l)	EQS MAC (µg/l)	Dilution Required to meet MAC EQS	Absolute minimum dilution available in mixing zone	EQS AA (µg/l)	Dilution Needed to meet AA EQS	Average dilution Available In mixing zone
Cadmium	2	N/A	N/A	240:1	0.2	10 :1	16,800 :1
Chromium	23	32	0	240:1	0.6	38.3 :1	16,800 :1
Copper	30	N/A	N/A	240:1	10.9	2.75:1	16,800 :1
Iron	485	N/A	N/A	240:1	1000	0	16,800 :1
Lead	5	14	0	240:1	1.3	3.8 :1	16,800 :1
Mercury	2.1	0.07	30	240:1	N/A	N/A	16,800 :1
Nickel	14	34	0	240:1	8.6	1.6 :1	16,800 :1
Zinc	122	N/A	N/A	240:1	7.9	1,544 :1	16,800 :1

Table 4 – Dilution required to meet existing background concentrations

Substance	Maximum Conc in Effluent (µg/l)	Annual Average Background Concentration in the Blackwater Estuary S.E of West Mersea (µg/l)	Dilution Required to meet AA Background Concentrations	Average dilution over 24 hours
Cadmium	2	0.018	111:1	16,800 :1
Chromium	23	0.250	92:1	16,800 :1
Copper	30	1	30:1	16,800 :1
Iron	485	50	9.7:1	16,800 :1
Lead	5	0.024	208.3:1	16,800 :1
Mercury	2.1	0.008	262.5:1	16,800 :1
Nickel	14	0.94	14.8:1	16,800 :1
Zinc	122	1.2	101.6:1	16,800 :1

On this basis we are confident that the treated radioactive site drainage effluent will not pose a threat to any of the receptors in the receiving waterbodies. The Applicant's impact assessment, with corrections (including the right water quality standards), show that the metals concentrations in this effluent screen out as 'insignificant'. Their modelling exercises (which we have verified as fit for purpose) provide additional evidence going beyond H1 requirements to back up this conclusion.

Mixed Effluents Discharge

- Metals

For this discharge we have concluded that the Applicant's assessment followed H1 guidance. We have also concluded that the Applicant's screening tests validly established that the only metal (chromium) that may be above EQS concentrations in the mixed effluents discharge is 'insignificant' in

H1 terms. This is unsurprising considering that the concentrations of chromium in the mixed effluents discharge are low in relation to EQS's. The maximum concentration detected (6.77 µg/l) is below its MAC EQS (32 µg/l) and the average concentration (3.88 µg/l) is only just over 6 times the chromium AA EQS (0.6 µg/l). Because the traces of metals in the mixed effluents discharge come from an intermittent source (rainfall related site drainage) the use of annual average (AA) EQS's is also likely to be over conservative. AA EQS's aim to protect the environment from substances inputted in continuous (daily) discharges. In addition to being intermittent, a proportion of the mixed effluents discharge will contain concentrations of metals (including chromium) that are much less than those in Table 1 above. This is because they will be diluted to various degrees by additional clean site runoff.

In this case Agency specialists undertook further modelling work of their own to address queries raised by Natural England about potential 'in combination' effects discharges under the Permit together with discharges of treated FED effluent. This modelling provides further evidence that the metals in the mixed effluents discharge will not have any significant adverse effects.

The Agency's modelling used the information provided by the Applicant to calculate 'initial dilution' (ID) factors for the mixed effluents discharge. ID factors are more conservative than the dilution factors produced by the more sophisticated models used by HR Wallingford. This is because they only take account of the dilution the effluent receives as its buoyancy causes it to move upwards in the water column and not any dilution as it mixes horizontally across a mixing zone. The most conservative dilution factor is the 'still water' factor because this does not even take account of any movement of water laterally through the water column that currents produce. This is therefore an unrealistic factor although it can be used to rule out further analysis. In this case the Agency calculated that the 'still water' ID for the mixed effluents discharge is 9.2:1.

As set out in section 6.12 above the only metal in the mixed effluents discharge detected in higher concentrations than any EQS is chromium (chromium has an annual average EQS of 0.6µg/l whereas the average detected concentration in the effluent is 3.88 µg/l). To reduce chromium's concentration from 3.88 µg/l to below the AA EQS of 0.6µg/l needs dilution by 6.5:1. The still water ID of 9.2:1 achieves this. As this is a highly conservative factor we can be confident that allowing for lateral movements of water within the column and the full range of tides there will be no breach of the AA EQS even on one day. This analysis is therefore very precautionary even though it does not take account of background concentrations. It should be noted that because the maximum concentration detected in the effluent is much lower than its MAC EQS there is no risk of any direct toxic effect by exposure over a few hours. It should also be noted that when there is any rainfall on the site this will dilute the mixed effluents discharge and the concentrations of all the metals in it will be lower. This may also cause chromium concentrations to be lower than EQS before discharge.

All these factors add to the screening out of the effluent as ‘insignificant’ in H1 terms and give us confidence that the mixed effluents discharge poses no risk of breaching any water quality standards outside a very limited mixing zone so will not pose a risk to any receptors. ‘Insignificant’ in H1 terms also means that the concentrations will not threaten any significant deterioration of background concentrations.

- Pathogens (Secondary Treated Sewage Effluent)

As set out at section 6.11 above, the Agency’s approach to protecting shellfish and bathing waters from pathogen load is to require an appropriate level of reduction of pathogens between the raw sewage influent to the treatment plant and the receiving waters. This reduction can sometimes be achieved by secondary treatment and the dilution between the outlet for the discharge and the designated protected area. But if these combined reduction factors are insufficient the gap must be made up by tertiary treatment of the effluent by UV disinfection of known dosage strength.

EPR 7.01 explains that to meet the shellfish water standards an overall reduction of 5.25 log (180,000 fold) is needed and that to meet the highest bathing water standard requires 5.4 log (250,000 fold) reduction. It also explains that secondary treatment of sewage achieves a reduction of 1.5 log (32 fold).

In this case with regard to the reduction by dilution of pathogens in the receiving waters we have used the 9.2:1 dilution factor for ‘still water’ calculated by our modelling expert (see discussion above). This is because the mixed effluents discharge is made directly into the shellfish protected area. We are therefore only allowing for the dilution the effluent will receive as it rises within the water column from the outlet to the surface. This level of dilution provides a 0.96 log reduction. Together with the 1.5 log reduction for secondary treatment, this leaves a further 2.79 log reduction to achieve a total reduction of 5.25 log. This can be achieved by UV disinfection to meet the shellfish water standards at the surface of the water column above the outlet.

The result of our assessment is, therefore, that tertiary treatment of the sewage effluent with UV disinfection facilities to achieve a 2.79 log reduction in its Escheria coli (E coli) and Intestinal enterococci load is required. This, together with the existing 2.46 log reductions from dilution and secondary treatment will achieve a log 5.25 reduction to meet the shellfish water standards. This assessment is a worst case scenario that assumes that the whole 130 m^3 is made up of sewage effluent and that the absolute minimum ‘still water’ dilution applies. Such occasions will be rare and the fact that the ‘still water’ dilution has been used makes even this estimate very conservative. If there is any rainfall prior to discharge the secondary treated sewage effluent component of the discharge will be diluted and on many occasions the dilution in the estuary will be much higher. For the vast majority of the time therefore the bathing standards will also be achieved when the effluent has mixed within the water column.

6.14 Conclusions and the implications for permit limits and conditions

As explained in section 4.2 above, the Applicant has requested changes to its previous permit necessitated by the silting up of the existing outlet to the estuary which will make it unusable at some time in the near future. Once this occurs the Applicant wishes to be able to discharge from new outlets.

This means that the Permit has to have conditions that protect the receiving environment from the discharge as currently occurs (i.e combined effluent streams in a large carrier flow of abstracted seawater) and for the future situation (i.e. discharge through the new outlets at a lower volume and with the treated radioactive site discharge occurring separately).

This section will therefore outline our approach to deciding the appropriate permit conditions and limits for these two scenarios.

Discharge of the combined effluents in a carrier flow of abstracted seawater

Because there has been no material change to the individual effluent streams, or the method of discharge (by using a carrier flow of abstracted seawater to displace them through the existing outlet) we have no reason to impose any additional conditions or emission limits on the Permit for this discharge.

However the Applicant has informed us that they have already installed and commissioned the appropriate UV disinfection facilities mentioned above. We have therefore (for additional environmental protection) made the permit conditions requiring this treatment apply to the current discharge regime through the existing outlet as well as the future discharges through the new outlet. The only other change to the emission limits we have made is the removal of a 500 µg/l limit for ‘Total residual oxidant expressed as chlorine’. This limit appears to be a residue of previous permits from the time when the discharge included cooling waters from an active power station. Such waters would have been treated with chlorine to prevent bio-fouling in the circulating cooling waters. There is no longer any need for chlorine to be added, and no chlorine detected in the discharge, so there is no longer a need for this limit.

Future discharges of treated radioactive site drainage through the new outlet

Metals

The use of the new outlet in future for the treated radioactive site drainage and its separation from the other effluents will not change its contributing polluting load of metals. The only difference the change to the new outlet will make is the way the treated radioactive site drainage is diluted and dispersed within the receiving estuary. As outlined above, the H1 Annexe D1 screening tests established that the metals detected in this effluent can be considered as ‘insignificant’ and that the mixing zone for them is acceptable. There is additional evidence from hydrodynamic modelling that outside a mixing zone the metals in the discharge will not threaten relevant water quality standards.

Under H1 guidance a hazardous substance that passes the screening tests does not require a numeric limit within a permit to protect the receiving environment.

Consequently we have not included emission limits for metals in the Permit.

Temperature

There are no thermal inputs to the treated radioactive site drainage and it will be discharged at near ambient temperature. There is therefore no need for a temperature limit on this effluent.

pH

pH adjustment is part of the treatment process to reduce metals such that the pH of the treated radioactive site drainage will be in the range of 6 to 9. There are no specific pH standards to meet in the receiving waters under the WFD but there are guideline standards of maintaining pH within the range of 7 to 9. There is more than sufficient dilution within the mixing zone for this to be achieved outside it and only receptors within the upper water column of the mixing zone in close proximity to the outlet (for the very brief period of discharges) would be at any risk at all. There would be no risk to receptors on the estuary bed because the discharge is buoyant. For these reasons there is no need for a pH limit on the Permit to protect receptors. However a limit of pH 6 to 9 will be a useful additional check that effective treatment has taken place and we have included a suitable condition in the Permit for this reason (see section 7 below).

Future discharges of the mixed effluents discharge through the new outlet

The only effluents within the mixed effluents discharge that contain pollutants that have the potential to cause any adverse effects within the receiving waterbodies are (i) the treated non-radioactive site drainage (containing metals) and (ii) the secondary treated sewage effluent (containing pathogens). The clean site drainage and the waste waters from the reverse osmosis plant only serve to provide dilution for these other two sources.

- Treated non-radioactive site drainage

Metals

As with the treated radioactive site drainage the only difference a discharge of the mixed effluents discharge through the new outlet will make is that the same polluting load will be diluted and dispersed differently. This will make no difference to the existing background concentrations of pollutants in the wider receiving waterbody, but it could change them in the near vicinity of the outlet in the short term. However, in common with the metals concentrations of the treated radioactive site drainage, those of the treated non-radioactive site drainage passed the screening tests in H1 guidance. They are therefore considered to be 'insignificant' and unable to have any adverse effects on any receptor outside an acceptable mixing zone around the outlet. The additional 'initial dilution' modelling of Agency specialists backed up this conclusion by showing that there is sufficient dilution just within the water column as it rises to reduce the only metal (chromium) within the treated non-radioactive site drainage that exceeds its EQS in the discharge to meet it at the surface. These and additional factors that make this analysis very conservative mean that (as H1 guidance indicates) there is no requirement for numeric emission limits for metals within the mixed effluents discharge on the Permit.

Temperature

There are no thermal inputs to the mixed effluents discharge and it will be discharged at near ambient temperature. There is therefore no need for a temperature limit on this effluent.

pH

In common with the treated radioactive site drainage, a pH limit on the mixed effluents discharge will be a useful extra check that effective treatment has taken place. We have therefore included a suitable condition in the Permit for this reason (see section 7 below).

- Secondary treated sewage effluent

The main purpose of a conventional sewage treatment plant (STP) is to reduce the biochemical oxygen demand (BOD) of raw sewage to prevent it de-oxygenating the receiving waters. Secondary treatment also reduces the ammonia concentrations, suspended solids (SS) and the pathogen load in raw sewage. Standard STP's such as the one on the Bradwell site are designed to consistently achieve emission standards of 20 mg/l BOD, 30 mg/l SS and 20 mg/l ammonia but they are not designed to achieve any specific pathogen standard. If the removal of pathogens to a specific standard is required additional, tertiary disinfection treatment is needed. This is usually in the form of the exposure of the effluent to the appropriate dosages of Ultra Violet light from bespoke UV lamps. For the treatment to be effective the effluent has to be low in suspended solids so that the UV light can properly penetrate to the pathogens within it.

We are confident that the 20 mg/l BOD, 30 mg/l SS and 20 mg/l ammonia that the Applicant's STP is designed to achieve will not pose any risk to the receptors of the receiving environment without pre-dilution. Even in the worst case scenario of discharges of sewage effluent occurring in a period of dry weather there will be sufficient dilution even within a very limited mixing zone to prevent the BOD, SS's and ammonia having any significant adverse effects. However we are not confident that, if relying on the Applicant's STP alone, there will be sufficient dilution in the receiving waters in all the potential circumstances of discharge timing to prevent a breach of the appropriate micro-biological standards for the protection of shellfish for human consumption.

As stated above we have calculated that to achieve this standard a further reduction of log 2.79 is needed by UV disinfection. To achieve this reduction factor we have also calculated that UV facilities capable of delivering a minimum dose of $30mJs/cm^2$ will be required to treat the secondary effluent. The Applicant has confirmed that they have already installed UV disinfection facilities that will achieve this standard. The permit has the appropriate conditions to enforce it.

Overall Conclusion

Our assessment of the Applicant's proposed changes to the existing discharge is that (with the exception of the secondary treated sewage effluent component) they will;

- not threaten any breach of any relevant EQS's in the receiving estuary outside an allowable mixing zone and therefore not pose any risk of deterioration from 'Good' status for relevant chemical elements or any adverse effect on any receptors outside this very small area
- not lead to any significant deterioration of the existing background water quality for any of the pollutants they contain outside the allowable mixing zone

With regard to the secondary treated sewage effluent, the additional UV disinfection treatment required by the permit has already been installed and will ensure that even in worst case circumstances when the new outlet is used, and there is no pre-dilution, the shellfish standards will be met in the designated protected shellfish waters.

7. The Permit

We set out below how we have reflected the matters discussed above in the conditions included in the Permit.

7.1 <u>Emission limits</u>

7.1.1 Current discharge of all the effluents in admixture in a carrier flow of abstracted seawater through the existing outlet (Activity A1 on the Permit)

We have not changed the emission limits for this except to remove the limit for 'Total residual oxidant' and to add the UV disinfection conditions (Table S3.3)The other emission limits in Table S3.1 are for maximum volume, pH 6 to 9 and 'no significant trace of visible oil or grease'. The latter is a standard descriptive limit for site drainage effluents from large industrial sites.

7.1.2 Future discharges of treated radioactive site drainage from the new outlet (Activity A2 on the Permit)

As set out in section 6.14 above, there is no need to have numeric emission limits for the traces of metals within this discharge. The only need for numeric limits, besides the maximum daily volume, is a pH of 6 to 9 and the 'no significant trace of visible oil or grease' condition (Table S3.1 Activity A2)

7.1.3 Future mixed effluents discharge from the new outlet (Activity A3 on the permit)

As with the radioactive site drainage there is no need for metals limits on this discharge, but we have included a pH 6 to 9 limit for the monitoring of effective treatment and a 'no significant trace of visible oil or grease' condition because the discharge includes site drainage.

The only other emission limits that apply to the mixed effluents discharge are those to ensure the effective removal of pathogens to meet the shellfish standards. There is a dose strength of 32 mJs/cm^2 (milli joules per square centimetre) and percentage transmittance figure of 45% in Table S3.3 and a 40 mg/l BOD limit and a 60 mg/l SS limit in Table S3.1. The BOD and SS limits are to ensure that the secondary treatment will be effective and have removed its share of pathogens before the UV treatment takes place.

The above dosage strength was calculated in accordance with our guidance for the protection of shellfish for human consumption.

7.2 <u>Limits of specified activity</u>

These sections of a standard EPR permit (Tables S1 in Schedule 1) allows us to put a brief descriptive condition into the Permit to control some aspect of the discharge in a way that is difficult to incorporate in any other section. In this case we have included a condition concerning the specific timing of the discharges in relation to the tides.

7.2.1 Timing of the discharge - Current discharge of all the effluents in admixture in a carrier flow of abstracted seawater through the existing outlet (Activity A1 on the Permit)

The existing discharge occurs on any tidal state and there is no need to change this because the pre-dilution in large volumes of abstracted seawater removes any risk to the receptors of the receiving environment.

7.2.2 Timing of the discharge - Future discharge of treated radioactive site drainage (Activity A2)

The justification for this discharge in the Application includes dilution factors calculated from the discharge occurring between 1 and 2.5 hours of the high water of ebbing tides. At these times the dilutions available in the receiving waters will ensure that there is no risk to any receptors in the receiving environment. In order to ensure we can enforce compliance with this timing we have incorporated it in the limits of specified activity in Table S1.1b of page 11 of the Permit under the Activity A2 reference.

7.2.3 Timing of the discharge - Future mixed effluents discharge from the new outlet (Activity A3)

This discharge can occur on any time or state of a tide and our assessment has concluded that there is sufficient dilution within the receiving waters for there to be no adverse effect on any receptor in these circumstances. We have therefore not imposed any specific timing within the Permit for this discharge.

7.3 Operating techniques

Operating techniques are used within EPR permits when it is necessary to make sure that the operator will use certain techniques, methodologies, systems or procedures that are essential for the discharge to meet all the other conditions of the Permit and protect the receiving environment but which are too complex to fit into the tables of the schedules in full. By referencing these external documents in Table S1.2 of Schedule 1 we can enforce the use of whatever techniques and systems they outline.

7.3.1 New outlet structure (Activity A2)

We have included a reference to an operating technique in Table S1.2 of Schedule 1 of the Permit which requires the Operator to use an outlet that conforms to the design specification they have outlined in their Application. This will ensure that the dilution and dispersion characteristics that will protect the environment are achieved when the new outlet has to be utilized. This technique only applies to Activity A2 which is the discharge of treated radioactive site drainage through the new outlet. It is only this discharge that requires specific dispersion characteristics to achieve dilution factors that will ensure that the receptors of the receiving environment are protected.

7.3.2 Analytical techniques and methodology (Activities A2 and A3)

The Permit will have conditions requiring the Operator to take representative audit samples of the discharges from the treated radioactive site drainage and treated non-radioactive site drainage effluents and analyse them for the metals that have been detected in these effluents (as listed in Table S.3.1) when the new outlets are used. These samples will not be for compliance purposes because we have not imposed numeric limits for the relevant metals on the Permit (see sections 6.14 and 7.1 above). They are for reporting to the

Agency so that we can verify that the values give in the Application are representative.

In order to have confidence in the results we need to know that the analysis was carried out properly to industry standards. In the case of the treated radioactive site drainage the Applicant may have difficulty finding an independent lab that is set up to deal with samples that have a low level of radioactivity. However the Applicant already has a laboratory on site to deal with this problem. Their primary testing method for metals is, 'Inductively Coupled Plasma Mass Spectrometry' (ICPMS). Specialists in the Agency's laboratory service have investigated the Applicant's analytical systems and procedures, and have concluded that their analytical operation is fit for purpose.

A detailed 'operating technique' document that outlines the Applicant's analytical methods and procedures, and the auditing of them, is referenced in Table S1.2 of Schedule 1 for Activity A2. This will ensure that we can enforce the Applicant's adherence to the necessary testing regime for producing reliable sample results. A similar operating technique for testing the metals in the non-radioactive site drainage (Activity A3) is also referenced in Table A1.2.

7.3.3 Flow monitoring (Activities A2 and A3)

The Agency's default standard for flow measurement is 'MCERTS' which is a professional certification scheme for flow measurement operations which includes criteria for flow measurement devices, calibration and qualified auditors. The Applicant has confirmed that they operate MCERTS for the discharge of treated radioactive site drainage (activity A2) and an operating technique to this effect is referenced in table S1.2 of the permit.

For the treated non-radioactive site drainage discharge we have waived the need for an MCERTS standard for measuring its flow because its potential polluting load is much lower than the treated radioactive site drainage and its maximum daily flow can be limited by establishing the maximum daily capacity of the treatment plant An operating technique establishing this maximum capacity will be included as a substitute for MCERTS flow measurement as explained below.

The operating techniques for flow apply to the discharges through the new outlet only because they are not required whilst the effluents are pre-diluted in large volumes of abstracted seawater and discharged through the existing outlet.

7.3.4 Float switch pump setting arrangement

The non-radioactive site drainage effluent must achieve the minimum level of dilution in the other effluents making up the mixed effluents discharge to meet the metals concentrations outlined in the Application. To ensure that this is the case the float switch arrangement outlined within the Application must be adhered to. We have included an operating technique (which we can enforce compliance with) to this effect in Table S1.2.

7.3.5 Capacity of silt buster treatment plant

We have required the Applicant to provide an operating technique which stipulates the maximum capacity of the silt buster treatment plant. This is necessary to ensure (in conjunction with the above operating technique for the pumping arrangement) that the treated non-radioactive site drainage gets the correct level of dilution within the other effluents in the mixed effluents drainage during dry weather. This dilution is necessary to achieve the metals concentrations stipulated in the Application for the mixed effluents discharge.

7.3.6 Capacity of the STP

To be sure we only permit a maximum of 45 m^3 of treated sewage effluent being discharged into the combined holding chamber we have required the Applicant to provide an operating technique stipulating this.

7.3.7 Sampling frequencies for treated site drainage effluents

The Permit will require monitoring of the volume and quality of the treated radioactive site drainage and the non-radioactive site drainage (Activities A2 and A3). For most types of effluent we would also specify a frequency at which samples and measurements should be taken (i.e. weekly, monthly, quarterly etc.) to make sure that there is a representative spread of results across each year. However this is not feasible for site drainage discharges because in sustained dry periods there may not be any discharges to sample.

We have therefore required the Applicant to provide an operating technique (Table S1.2) that will specify a minimum frequency of annual sampling (12) and outline how these will be spaced out across the rainfall events of a year to be representative.

7.4 Monitoring, recording and reporting

7.4.1 Monitoring and recording

Table S3.1 in Schedule 3 of the Permit lists every parameter of the discharges that other sections of the Permit will require to be monitored by the Applicant. For the current discharge through the existing outlet (Activity A1) we are not requiring monitoring because of the large pre-dilution in the carrier flow of seawater. This is in accordance with the existing Permit.

For the future discharge of the treated radioactive site drainage effluent (Activity A2) the table stipulates that the Operator should analyse samples for all the metals detected in the effluent and its pH and measure its volume.

As described at section 7.3.7 above, the frequency of sampling will be controlled by adherence to an operating technique we have required the

Applicant to produce. That is a sampling frequency regime that will ensure a representative spread of 12 samples taken after, or during, rainfall events over a year.

For the future mixed effluents discharge (Activity A3) through the new outlet the Permit requires a similar monitoring program to that for Activity A2. The Applicant is required to sample and analyse the metals that have been previously detected in the non-radioactive site drainage in accordance with an operating technique stipulating a minimum of 12 samples a year. In order to be representative, this effluent will be sampled before it is mixed with the other effluents in the holding chamber. The parameters that have to be monitored are listed in Table S3.1 and the monitoring point for samples to be taken before it enters the holding chamber is listed in Table S3.4.

With regard to the monitoring for compliance with the BOD and SS emission limits for the secondary treated sewage effluent (Activity A4) in Table S3.1 and compliance with the UV dosage requirements specified in Table S3.3 the Agency will undertake this in line with our current guidance for such monitoring.

7.4.2 Reporting

Schedule 4 of the Permit outlines the reporting requirements the Operator has to comply with. This is only relevant to the discharges through the new outlet as we have not required any monitoring for the discharge of all the mixed effluents in the large carrier flow of abstracted seawater through the existing outlet.

Table S.4.1 stipulates that the Operator shall provide quarterly reports of all the information they have recorded from the monitoring program stipulated in the Permit as described above. This will enable us to have an ongoing review of the metals results to make sure that they conform to the characterisations of the effluents in the application. If they do not conform and the metals concentrations in the effluents are significantly different we will re-assess their polluting potential and, if necessary, vary the Permit to set appropriate numeric limits to protect the receiving environment.

8 Other legal requirements

In this section we explain how we have addressed other relevant legal requirements, to the extent that we have not addressed them elsewhere in this document.

8.1 The EPR and related Directives

8.1.1 Regulation 60 of the EPR

Regulation 60 of the EPR requires the Agency to prepare and publish a statement of its policies for complying with its public participation duties. We have published our public participation statement.

This Application is being consulted upon in line with this statement, as well as with our guidance RGS6 on Sites of High Public Interest, which addresses specifically extended consultation arrangements for determinations where public interest is particularly high. This satisfies the requirements of the Public Participation Directive.

Our decision in this case has been reached following a programme of public consultation. The way in which this has been done is set out in Section 2.2. A summary of the responses received to our consultations and our consideration of them is set out in Annexe 1.

8.2 National primary legislation

8.2.1 Environment Act 1995

(i) Section 4 (Pursuit of Sustainable Development)

We are required to contribute towards achieving sustainable development, as considered appropriate by Ministers and set out in guidance issued to us. The Secretary of State for Environment, Food and Rural Affairs has issued *The Environment Agency's Objectives and Contribution to Sustainable Development: Statutory Guidance (December 2002)*. This document:

> "*provides guidance to the Agency on such matters as the formulation of approaches that the Agency should take to its work, decisions about priorities for the Agency and the allocation of resources. It is not directly applicable to individual regulatory decisions of the Agency*".

It requires the Agency;

> "*To protect, enhance and restore the environmental quality of inland and coastal surface water and groundwater, and in particular to address both the point source and diffuse pollution; to implement the EC Water Framework Directive; and to ensure that all relevant water quality standards are met.*"

The Agency considers that it has pursued the objectives set out in the Government's guidance where relevant, and that there are no additional conditions that should be included in the Permit to take account of the section 4 duty.

(ii) Section 5 (Pollution of the Environment)

The Agency must exercise its powers, when determining this Application, for the purpose of preventing or minimising, remedying or mitigation the effects of pollution of the environment.

In assessing the Application and setting permit limits and conditions we have ensured that the Applicant will comply with the requirements of WFD, in particular the requirement not to allow deterioration in status of receiving water body. We have also used our guiding principle of limiting the potential effects of the treated effluents to causing no more than a 10% in-status deterioration for any pollutant the discharges contain. In this case, the metallic pollutant concentrations the discharges contained were assessed to be insignificant and had no potential to threaten any water quality standard in the receiving waters or cause any significant levels of deterioration in them if the treatment systems are operated correctly and maintained. The management system and operating techniques ensure that the treatment systems will be maintained and operated correctly.

Regarding the pathogens contained in the secondary treated sewage effluent discharge, the Permit shall ensure that these are controlled prior to discharges by the requirement for UV disinfection of the effluent within it.

Consequently, we consider that we have met the section 5 duty.

(iii) Section 6(1) (Conservation Duties)

Consideration has been given to the Agency's duty to promote the conservation and enhancement of the natural beauty and amenity of inland and coastal waters and the land associated with such waters, and the conservation of flora and fauna which are dependent on an aquatic environment. We consider that the conditions of the Permit will be sufficient in this regard and no other appropriate requirements have been identified.

(iv) Section 6(6) (Fisheries Duties)

It is the duty of the Agency to maintain, improve and develop salmon fisheries, trout fisheries, freshwater fisheries, lamprey, smelt and eel fisheries.

We consider that the changes the Applicant has requested to the previous permit to take account of the need to use the new outlets in the future will not significantly change the background water quality in the receiving waterbodies outside very limited mixing zones or cause a breach of any water quality standards there. The size of the mixing zone is limited so any changes within it are considered insignificant. Because the water standards for estuarine waters have been devised to protect all aquatic flora and fauna, including fish and their habitats, we consider that the Permit will also enable us to fulfil our section 6(6) duty.

(v) Section 7 (Pursuit of Conservation Objectives)

We have considered whether we should impose any additional or different requirements in terms of our duties under section 7. We consider that the discharge cannot affect the elements referred to under section 7, or else that the Permit will adequately control the discharge to ensure that these elements are protected. Consequently we have concluded that no other measures are required to comply with the section 7 duty.

(vi) Section 39 (Costs and Benefits)

The Agency has a duty under section 39 of the Environment Act 1995 to take into account the likely costs and benefits of granting the Application (‘costs’ being defined as including costs to the environment as well as any person).

We are confident that the conditions of the Permit will ensure that the discharge it allows will pose no threat to any receptors outside a very limited mixing zone (and that any threat within that zone is insignificant). This means that the Permit will provide the same level of protection for the receiving environment as the previous permit did for the discharges made through the existing outlet. We are therefore confident that granting the Permit does not increase any existing environmental costs. We also consider that the costs that the Permit may impose on the Applicant are reasonable and proportionate in terms of the benefits it provides.

8.2.2 Human Rights Act 1998

We have considered potential interference with rights addressed by the European Convention on Human Rights in reaching our decision and consider that our decision is compatible with our duties under the Human Rights Act 1998. In particular, we have considered the right to life (Article 2), the right to a fair trial (Article 6), the right to respect for private and family life (Article 8) and the right to protection of property (Article 1, First Protocol). We do not believe that Convention rights are engaged in relation to this determination.

8.2.3 Countryside and Rights of Way Act 2000

Section 85 of this Act imposes a duty on the Agency to have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty (AONB). There is no AONB which could be affected by the mixed effluents discharge or treated radioactive site drainage discharged from the Bradwell site.

8.2.4 Wildlife and Countryside Act 1981

Under section 28G of the Wildlife and Countryside Act 1981 the Agency has a duty to take reasonable steps to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which a site is of special scientific interest. Under section 28I the Agency has a duty to consult Natural England in relation to any permit that is likely to damage SSSIs.

We assessed the Application and concluded that the discharge will not damage the special features of any SSSI. This was recorded on a CROW Appendix 4 form, which we used to consult Natural England who agreed with our conclusion.

Our CROW assessments in the form of the Appendix 4 consultation documents submitted to Natural England are given in Annexe 2 of this document.

8.2.5 Natural Environment and Rural Communities Act 2006

Section 40 of this Act requires us to have regard, so far as is consistent with the proper exercise of our functions, to the purpose of conserving biodiversity. We have done so and consider that no different or additional conditions in the Permit are required.

8.2.6 Marine and Coastal Access Act 2009

Amongst other things this Act brought into being the framework for the establishment and protection of Marine Conservation Zones. It appointed Natural England as the body to set criteria for their creation and to designate the features to be protected and the conservation objectives to achieve this. The Blackwater, Colne, Roach and Crouch Estuaries MCZ was designated as a result of the Act.

The Agency's role with regard to permitting is to ensure that our decision accords with the relevant marine policy documents. Further, where our permitting decisions are capable of affecting (other than insignificantly) the MCZ's protected features or processes upon which they are dependent we must (a) exercise our functions so as to best further, or else least hinder, the MCZ's conservation objectives and (b) only grant the Application if it poses no significant risk of hindering the achievement of the objectives (or else if the Applicant demonstrates that an overriding public interest exception applies). We work with Natural England to achieve this and ultimately have to obtain their formal agreement if we decided to grant, or vary, a permit.

The Blackwater Estuary and other waterbodies in the vicinity of the discharges from the Bradwell Site are within the 'South East Marine Plan' area which has been designated by the Marine Management Organisation (MMO) under the above Act. This area covers approximately 1,400 kilometres of coastline between Felixtowe and Dover. However, at the moment the South East Marine Plan is in development. The MMO are in the middle of a public consultation process and there is no draft or completed document available for us to take account of in our determination.

In the absence of a draft or completed we have considered the generic information in the published marine policy documents and the advice produced by Natural England for meeting the conservation objectives of the Blackwater, Colne, Roach and Crouch Estuaries MCZ. As described in section 6 above, we have assessed the potential impacts of the treated radioactive site drainage and mixed effluents discharge (through both outlets) upon the receiving waterbody, including the MCZ. We have established to our, and Natural England's, satisfaction that there will be no adverse effects on any designated features of the MCZ. We consider that we have therefore met the requirements of the above Act.

8.3 National secondary legislation

8.3.1 The Conservation of Natural Habitats and Species Regulations 2010

We have assessed the Application in accordance with guidance agreed jointly with Natural England and concluded that there will be no likely significant effect on any European Site (a SAC or a SPA) or a Ramsar site.

We consulted Natural England by means of Appendix 11 assessments. They agreed with our conclusion that the discharge would not have a likely significant effect on the interest features of protected sites.

Our habitats assessments in the form of the Appendix 11 consultation documents we submitted to Natural England are given in Annexe 2 to this document.

8.3.2 The Water Environment (Water Framework Directive) Regulations 2003

As required by regulations 3 and 17 of these Regulations, in reaching this determination the Agency has exercised its functions so as to secure compliance with the WFD and EQS Directive and has had regard to the RBMP for this river basin district which has been approved under regulation 14 of these Regulations.

For the reasons given in this report the Agency is satisfied that granting this application on the conditions proposed will not cause the current status of the waterbodies in the vicinity of the discharge to deteriorate, and will not prejudice the aim of achieving overall 'Moderate' surface water status in them by 2021.

In addition to the requirement to achieve Moderate status by 2021, the WFD also requires the implementation of necessary measures with the aim of progressively reducing pollution from priority substances (including nickel, lead and mercury) and ceasing or phasing out emissions, discharges and losses of priority hazardous substances (including cadmium). These requirements are implemented in England at the strategic catchment level through the RBMPs.

For individual permits, if the treatment system proposed by the operator reduces substances in its discharges to concentrations that will maintain the existing waterbody status and will not prevent the WFD targets being achieved, the Agency considers that these additional requirements are met. This is the case with respect to the Permit.

ANNEXE 1: Consultation Reponses

A) Advertising and Consultation on the Application

The Application has been advertised and consulted upon in accordance with the Agency's Public Participation Statement and RGS6 as outlined in section 2.2 above.

Following the advertising of the Application on the Gov.UK website on the 5 August 2015 together with the other applications to vary the permits that the Applicant holds for the same site (and our subsequent notification of interested parties) we received 44 responses which have been placed on the public register.

1) Consultation Responses from Statutory and Non-Statutory Bodies

Maldon District Council	
Summary of issues raised:	**Our consideration of the issues**
N/A – No response received	

Kent and Essex Branch of Maldon District Council	
Summary of issues raised:	**Our consideration of the issues**
N/A – No response received	

2) Consultation Responses from Members of the Public and Community Organisations

The 44 responses we received from the consultation process are mainly aimed at the potential impact of the radioactive components of discharge of treated effluent arising from the FED operation. These are controlled by the permit EPR/ZP3493S. There are also areas of crossover into aspects of the non-radioactive components controlled by the permit EPR/DP3127XB. A summary of the issues raised and how we have addressed them is given in Annexe 1 in the accompanying decision document for the application EPR/DP3127XB.

There were no clear references in any of the responses to the changes the Applicant has requested to their Permit for the discharges outlined in this document.

ANNEXE 1b: Consultation Reponses – following 2nd ('minded to') consultation process of October 2016

A) Advertising and Consultation on the Application

The Application has been advertised and consulted upon in accordance with the Agency's Public Participation Statement. As outlined in section 2.2 and in this Annexe we received a great many responses to our initial consultation process and subsequently decided to undertake a second public consultation when we had reached our draft decision, also referred to as a 'minded to' decision. Our draft decision document and draft Permit were published on 20 October 2016 on an internet sharefile together with all the Application and supporting documents and further relevant information received from the Applicant post-application. The location of the sharefile was advertised in two local newspapers and we also emailed statutory consultees and all the interested parties known to us from previous consultations and correspondence. The initial end date for consultation responses was 17 November 2016 but this was subsequently extended until 15 December 2016 at the request of some respondents. It was necessary later when the sharefile expired to re-publish all the consultation documents on the Gov.UK website.

Following this exercise we received 39 responses which have been placed on the public register. But only one response raised an issue about the specific risks of a potential adverse environmental impact from one of the effluents in in this Permit. A summary of the specific issue raised and our consideration of it is given in the table below.

All the other responses related to issues concerning the discharges in Permits EPR/ZP34393SQ and EPR/DP3127XB. A summary of these issues and how we considered them is given in the equivalent Annexes in the decision documents for these permits published at the same time (14 March 2017) as this one.

1) Consultation Responses from Statutory and Non-Statutory Bodies

West Mersea Town Council - Councillor Sylvia Wargent (PR 6)	
Summary of issues raised	**Our consideration of the issues**
As a result of the discharges from the Bradwell site children of the island will be swimming in undiluted sewage effluent and those in sailing clubs will be at risk from the effluent because the clubs use areas of the estuary close to the effluent plume.	The discharge of treated sewage effluent from the sewage treatment plant (STP) at the Bradwell site is too small and too well-treated for the change in outlets to pose any significant risk to human health. The permitted maximum daily volume is 45 cubic metres a day and this will diminish as the workforce on site reduces with decommissioning. For comparison the sewage treatment

	works serving the residents of West Mersea has a dry weather flow of 2,000 cubic metres a day and it discharges its effluent into the estuary close to the edge of the town whereas the Bradwell STP outlet is over 3 kilometres across the estuary. The effluents are treated to a similar standard and receive UV treatment to reduce the bacteriological load. When there is any rainfall the Bradwell STP effluent will be diluted with clean runoff from the site before discharge. Even in dry weather there is good dilution for the effluent just within the water column as it rises to the surface and further dilution as its plume spreads out. For these reasons there will be no significant additional risk to bathers or other recreational users of the estuary from the Bradwell STP effluent when the new outlet is used.

2) Consultation Responses from members of the public and Community Organisations

None received.

Annexe 2 – Habitats consultation documents

The following documents comprise a record of the Agency's full formal consultation of Natural England regarding the proposed variations to the Permit and their potential to impact upon the Habitats sites listed in section 6.6.above.

(1) Blackwater Estuary SSSI – Non Radioactive site drainage

CRoW Appendix 4 (140_10_SD02)

CRoW Act 2000: Environment Agency application for permission - Formal Notice

Environment Agency

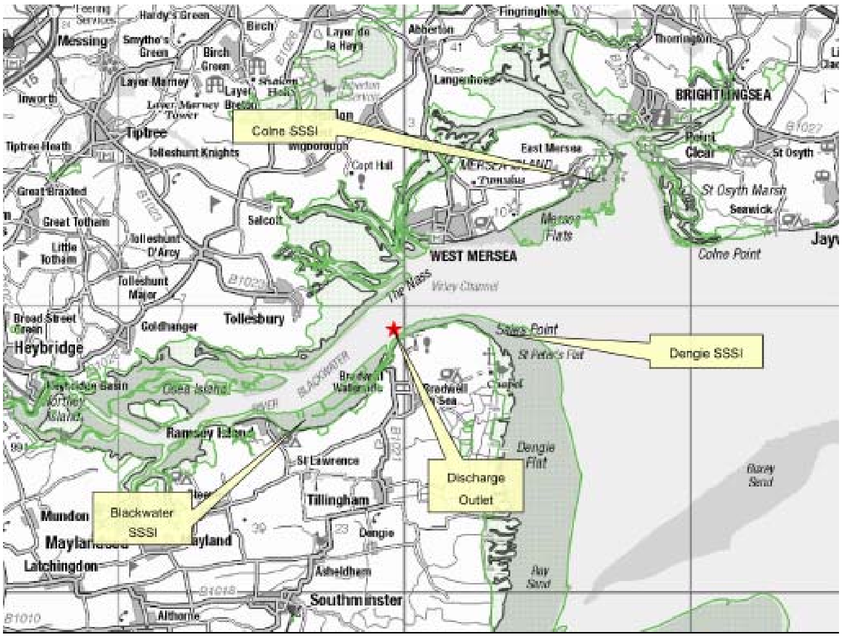
Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB).

Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000.

Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).

1. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
2. Name of SSSI:	Blackwater Estuary
3. Type of permission:	Environmental Permit – Water Discharge Activity
4. Date for Environment Agency permit determination:	**31/3/2016**
5. Predicted 28 day date for SNCB response (under S28 I(4)):	**25/2/2016**
6. Environment Agency reference no:	PR2TS/E10760C

7. National grid reference:	**TL 99650 09150**



8. Description of proposal:	**Brief Description of Proposal**

Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing.

The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit.

In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation

	of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of clean surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.' The new outlet for this discharge is in fact three small pipes of 180 mm diameter situated 3 metres above the seabed to prevent siltation. The effluents are all buoyant and will rise to the surface getting some initial dilution as they do so even in the lowest tides. With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals.

The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment and is designed to achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammoniacal nitrogen. In dry weather it will receive a minimum of just over three times dilution in the other effluents before discharge but in wet weather the dilution will be much greater. Because of this and because of the massive dilution in the receiving estuary (average flow 106,300,000 m3) such a small volume of treated sewage has no potential to cause any adverse effects and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one.

The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is potable water.

Treatment and discharge quality

The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it.

The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range of metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

Table 1 . Metals concentrations in mixed effluent discharge compared to EQS's

(Derived from Table 3 pg 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108)

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	**3.88**	**0.6**
Copper	11.54	N/A	3.23	10.9
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

9. Is the proposed activity within (wholly or partially) the SSSI boundary?	YES
10. Has there been any pre-application discussion or correspondence with SNCB?	NO

11. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Aggregations of breeding birds	Bearded Tit
Aggregations of breeding birds	Pochard
Aggregations of non-breeding birds	Bar-tailed Godwit
Aggregations of non-breeding birds	Black-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Curlew
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Gadwall
Aggregations of non-breeding birds	Goldeneye
Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Ringed Plover
Aggregations of non-breeding birds	Shelduck
Aggregations of non-breeding birds	Spotted Redshank
Aggregations of non-breeding birds	Teal
Coastal	Mesozoic - Tertiary Fish/Amphibia - A geological feature.
Coastal vegetated shingle	Coastal vegetated shingle
Ditches	Ditches
Invertebrate assemblage	Saltmarsh, estuary and mudflat
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Nationally scarce plant	Borrer's Saltmarsh-grass
Nationally scarce plant	Dwarf Eelgrass
Nationally scarce plant	One-flowered Glasswort

Nationally scarce plant	Slender Hare's-ear
Population of RDB plant	Saltmarsh Goosefoot
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand

The invertebrates inhabiting the mud flats and saltmarshes of the estuary which provide a food source for the internationally important populations of overwintering wildfowl and the various plant species which form and enrich the salt marsh habitats. It is clear from the citation that the Blackwater Estuary SSSI is of regional and national importance as a complex mosaic of estuarial habitats that support a large range of rare aquatic invertebrates and plant species which in turn provide a habitat for internationally important numbers of wildfowl species (including many rare ones) that are able to overwinter on site.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the receiving estuary so that none of the species or features it was designated for will be threatened by it

<u>Key concepts in the assessment :-</u>

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of

substances are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance,
In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals
The residual concentrations of metals in the discharge as outlined in Table 1 above are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium.. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS.

It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year.

Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being 'insignificant'. In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this.

We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge will have any significant adverse effect on any of the interest features of the SSSI. If we granted a permit the influence of the discharge would be limited to a small mixing zone around the outlet and there would be no direct instantaneous toxic or long term chronic effect even within this.

Temperature

The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the estuary and changing to a new outlet will not make a difference.

pH
The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the interest features of the conservation sites from pH effects and that the change to the new outlets and discharge arrangements would make no difference.

Turbidity
The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a

concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and therefore not have any significant effect on the interest feature of the SSSI. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion.

Siltation
As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation.

Salinity
None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the interest features of the SSSII.

Physical Damage
If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the conservation areas. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation.

12. Decision

i) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the mixed effluents from their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent.

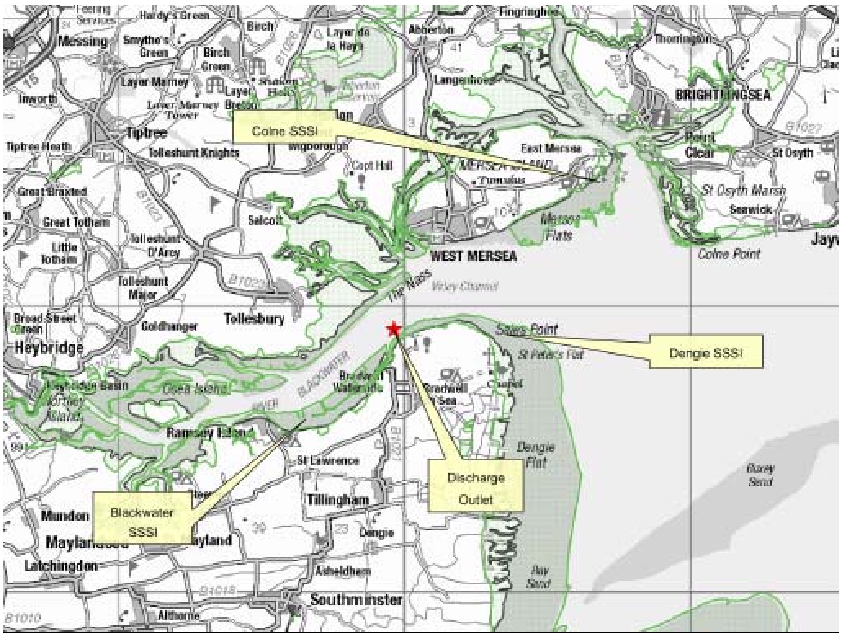
Permit Conditions

The permit will have a condition limiting the maximum daily volume in ‘ dry weather conditions’ to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*

13. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
14. Date form sent to SNCB:	**26/2/2016**
For Environment Agency use only, once SNCB response received	
15. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
16. Name and job title of SNCB officer:	
17. Date of receipt of SNCB response:	

(2) Blackwater Estuary SSSI – Radioactive site drainage

CRoW Appendix 4 (140_10_SD02) **CRoW Act 2000: Environment Agency application for permission - Formal Notice**	Environment Agency
Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB). Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000. Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).	

18.	**Environment Agency area/NPS hub:**	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
19.	**Name of SSSI:**	Blackwater Estuary
20.	**Type of permission:**	Environmental Permit – Water Discharge Activity
21.	**Date for Environment Agency permit determination:**	**31/3/2016**
22.	**Predicted 28 day date for SNCB response (under S28 I(4)):**	**28/3/2016**
23.	**Environment Agency reference no:**	PR2TS/E10760C
24.	**National grid reference:**	**TL 99650 09150** 
25.	**Description of proposal:**	**Site – Former Nuclear Power Station, Bradwell on Sea, Essex** **Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent

	deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of treated radioactive site drainage. The mixed effluent site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The maximum daily volume of this effluent will be 30 m3 because this is the maximum volume of the final delay tank. The pumps are manually controlled and discharges will only be made on one ebb tide per day between 1 and 2.5 hours after high water at a maximum rate of 11 litres per second which means it can all be discharged in 30 minutes., although it will probably be done over one hour. The new outlet is situated approximately 400 metres out into the estuary at the same location as the existing one but is 5.5 metres above the estuary bed. The 180 mm discharge pipe narrows to a nozzle of 65 mm and is at right angles to the main currents. This

	allows the maximum dispersion and dilution for the effluent. Because the discharge is rainfall dependent it will be intermittent and not continuous. The outlet for the effluent is the same one used for the FED effluent from the same site (as outlined on accompanying App 4) which is also likely to be intermittent. In the event that both discharges need to be made on the same day they will be made on different ebb tides. **Treatment and discharge quality** As stated above the source of this effluent is rainfall falling on those areas of the site that formerly housed the reactor. This is a smaller area than the non-radioactive areas so the volumes can be more easily controlled for treatment. Demolition during decommissioning has exposed crushed concrete to rainwaters which has led to highly alkaline waters sitting in voids leaching metals from dismantled structures and equipment. This alkaline water is collected and treated in an Aqueous Abatement plant with pH adjustment, ultra filtration absorption and ion exchange processes. The maximum concentrations of metals in the treated effluent are given in Table 1 below extracted from tables given in the application. They are based on samples taken when a particularly contaminated void on site was dewatered. This was a one-off exercise which will not be repeated. As such they are atypically high and represent a worst case scenario. **Table 1 – Concentrations of metals in the effluent and EQS's** **Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)**

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent(ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	10.9	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

26. Is the proposed activity within (wholly or partially) the SSSI boundary?	YES
27. Has there been any pre-application discussion or correspondence with SNCB?	NO

28. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Aggregations of breeding birds	Bearded Tit
Aggregations of breeding birds	Pochard
Aggregations of non-breeding birds	Bar-tailed Godwit
Aggregations of non-breeding birds	Black-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Curlew
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Gadwall
Aggregations of non-breeding birds	Goldeneye
Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Ringed Plover
Aggregations of non-breeding birds	Shelduck
Aggregations of non-breeding birds	Spotted Redshank
Aggregations of non-breeding birds	Teal
Coastal	Mesozoic - Tertiary Fish/Amphibia - A geological feature.
Coastal vegetated shingle	Coastal vegetated shingle
Ditches	Ditches
Invertebrate assemblage	Saltmarsh, estuary and mudflat
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Nationally scarce plant	Borrer's Saltmarsh-grass
Nationally scarce plant	Dwarf Eelgrass
Nationally scarce plant	One-flowered Glasswort
Nationally scarce plant	Slender Hare's-ear
Population of RDB plant	Saltmarsh Goosefoot
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand

The invertebrates inhabiting the mud flats and saltmarshes of the estuary which provide a food source for the internationally important populations of overwintering wildfowl and the various plant species which form and enrich the salt marsh habitats. It is clear from the citation that the Blackwater Estuary SSSI is of regional and national importance as a complex mosaic of estuarial habitats that support a large range of rare aquatic invertebrates and plant species which in turn provide a habitat for internationally important numbers of wildfowl species (including many rare ones) that are able to overwinter on site. The salt marsh and intertidal muds in the outer fringes of the estuaries that provide a contiguous wetland habitat with the Dengie and Foulness SSSI's that support a large range of waders and waterfowl which can overwinter there.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to any aquatic flora or fauna in the receiving estuary so that none of the species or features it was designated for will be threatened by it

Key concepts in the assessment :-

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010.

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threatened any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being insignificant it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones.

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals

The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only threat to the interest features of the SSSI from toxic effects. It can be seen from Table 1 above that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.

This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screen out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified that the all the metals screened out as 'insignificant'. . In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.

There is further evidence that the concentrations of metals in this effluent will be insignificant however because although this discharge passed the H1 screening test the FED effluent from the same site did not and the applicant engaged consultants to undertake detailed dilution and dispersion modelling for this. These models are also applicable to the radioactive site drainage discharge because it is discharged from the same outlet at similar rates and at similar times on an ebb tide. The modelling predicts that within 100 metres of the discharge point this effluent will be subject to an absolute minimum dilution factor of 250:1 and a minimum 'average' dilution of 700:. This is more than enough dilution to render all the metals in the discharge below there respective EQS concentrations. Unlike the FED effluent the site drainage effluent will be buoyant and will climb to the surface as it mixes so that no features on the sea bed could be affected even within the mixing zone.

We are therefore very confident that the metals in the discharge will have no significant adverse impact on any on the interest feature of the Blackwater Estuary SSSI outside the mixing zone and it is very likely that they will have any affect even within it.

Temperature

The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the features of the SSSI from the separation of the effluents and the use of the new outlet structure.

pH

The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is a minimum dilution of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the features of the Blackwater Estuary.

Turbidity and siltation

Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can have no effect on the interest features of even the receiving Blackwater Estuary SSSI.

Salinity

The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary. Changing to a new outlet structure will not change this situation.

Physical Damage

The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,00 m3) to have any physical effect on the interest features of the receiving Blackwater Estuary. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.

29. Decision

ii) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the treated radioactive site drainage their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis.

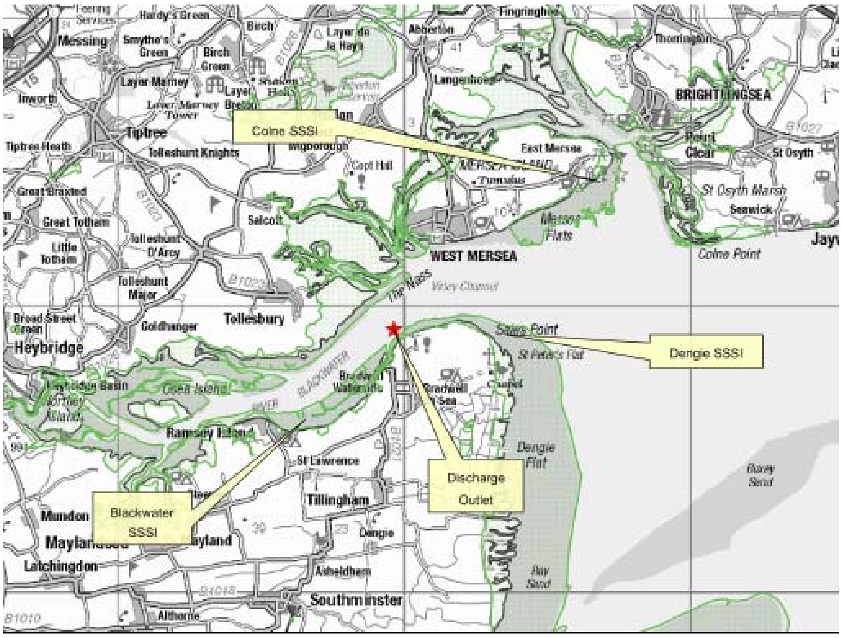
30. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
31. Date form sent to SNCB:	**29/2/2016**

For Environment Agency use only, once SNCB response received

32. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
33. Name and job title of SNCB officer:	
34. Date of receipt of SNCB response:	

(3) Colne Estuary SSSI – Non Radioactive site drainage

CRoW Appendix 4 (140_10_SD02) **CRoW Act 2000: Environment Agency application for permission - Formal Notice**	Environment Agency
Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB). Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000. Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).	
35. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
36. Name of SSSI:	Colne Estuary
37. Type of permission:	Environmental Permit – Water Discharge Activity
38. Date for Environment Agency permit determination:	**31/3/2016**
39. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3/2016**
40. Environment Agency reference no:	PR2TS/E10760C

41. National grid reference:	**TL 99650 09150** 
42. Description of proposal:	**Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the

	discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of clean surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this ‘worst case scenario’ discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as ‘130 m3 in dry weather conditions.’ The new outlet for this discharge is in fact three small pipes of 180 mm diameter situated 3 metres above the seabed to prevent siltation. The effluents are all buoyant and will rise to the surface getting some initial dilution as they do so even in the lowest tides. With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30

m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment and is designed to achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen. In dry weather it will receive a minimum of just over three times dilution in the other effluents before discharge but in wet weather the dilution will be much greater. Because of this and because of the massive dilution in the receiving estuary (average flow 106,300,000 m3) such a small volume of treated sewage has no potential to cause any adverse effects and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one.

The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is potable water.

Treatment and discharge quality

The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it.

The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range of metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

Table 1 . Metals concentrations in mixed effluent discharge compared to EQS's

(Derived from Table 3 pg 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108)

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	**3.88**	**0.6**
Copper	11.54	N/A	3.23	10.9
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

43. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
44. Has there been any pre-application discussion or correspondence with SNCB?	NO

45. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Active Geomorphological	Saltmarsh Morphology - A geological feature.
Aggregations of breeding birds	Little Tern
Aggregations of breeding birds	Ringed Plover
Aggregations of non-breeding birds	Black-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Ringed Plover
Aggregations of non-breeding birds	Sanderling
Coastal	Quaternary Of The Thames - A geological feature.
Coastal vegetated shingle	Coastal vegetated shingle
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Outstanding Dragonfly Assemblage	Outstanding Dragonfly Assemblage
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand
Broad SAC	Sandbanks Which Are Slightly Covered By Sea All The Time

The mudflats, salt marshes and grazing marshes of the Colne estuary which form part of the internationally *important wetland that supports and allows the overwintering of birds Brent Geese and Black Tailed Godwit and are important for breeding several species of waders and wildfowl. The invertebrates in these habitats which provide the food source for the birds. The salt marshes and intertidal muds of Mersea Flats and Colne point are the main areas that are theoretically susceptible to the influence of the discharge because they are closest to it*

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge it will not pose a risk to <u>any</u> aquatic flora or fauna within the SSSI so that none of the designated species or habitats will be threatened by it.

<u>Key concepts in the assessment :-</u>

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance,

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals
The residual concentrations of metals in the discharge as outlined in Table 1 above are the only potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium.. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS.

It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year.

Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium concentration in this discharge screened out as being 'insignificant'. . In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary

Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this.

The closest point of the SSSI to the discharge is Mersea Flats which is 4.7 kilometres from it across the Blackwater Estuary. Colne point is 9.2 kilometres from the discharge point. As stated above most of the metals in the discharge are below EQS levels and could not have any toxic affect on any flora or fauna even within a small mixing zone and chromium, the only metal which exceeds its EQS, could not to have any toxic effect beyond the mixing zone. The further dilution available across the estuary even on the lowest tides makes us even more confident that there could be no toxic effect from the discharges on the interest features of the SSSI from metals in the discharge.

Temperature

The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the estuary and changing to a new outlet will not make a difference.

pH

The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that changing the outlet structure for the mixed effluent discharge could have no significant adverse effects on the interest features of the Blackwater Estuary and definitely none on the Colne Estuary on the other side of it.

Turbidity

The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non –reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary and definitely none on the Colne Estuary on the other side of it. The change to the new outlet structure and discharge arrangements would therefore make not have any adverse effect on the interest features of the SSSI from turbidity effects.

Siltation

As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features that are close to it. There is therefore no possibility that the change to the new outlet structure could have any affect on the features of the Colne Estuary over four kilometres across the Blackwater Estuary. In other words the prevailing background conditions would not change with regards to siltation.

Salinity
None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the Blackwater estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the interest features of the Colne estuary SSSII over four kilometres away.

Physical Damage
If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any physical damage to the Blackwater estuary bed and could have no affect on the flow regime or physical features of the Colne Estuary over four kilometres away.

The absolute maximum of discharge permitted would be reduced from the current 500,000 m3 a day to 55,000 m3 a day so any potential for physical damage would be reduced from the current situation.

46. Decision

iii) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the mixed effluents from their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent.

Permit Conditions

The permit will have a condition limiting the maximum daily volume in ‘ dry weather conditions’ to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved

Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges.

The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped.

(*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*

47. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
48. Date form sent to SNCB:	**29/2/2016**
For Environment Agency use only, once SNCB response received	
49. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
50. Name and job title of SNCB officer:	
51. Date of receipt of SNCB response:	

(4) Colne Estuary SSSI – Radioactive site drainage

CRoW Appendix 4 (140_10_SD02)

CRoW Act 2000: Environment Agency application for permission - Formal Notice

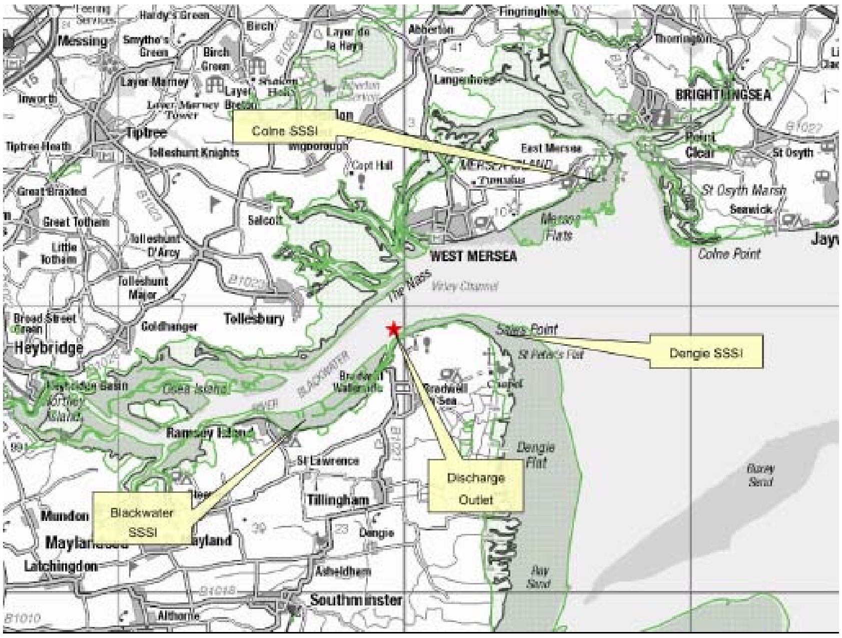
Environment Agency

Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB).

Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000.

Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).

52. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
53. Name of SSSI:	Colne Estuary
54. Type of permission:	Environmental Permit – Water Discharge Activity
55. Date for Environment Agency permit determination:	**31/3//2016**

56. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3//2016**
57. Environment Agency reference no:	PR2TS/E10760C
58. National grid reference:	**TL 99650 09150** 
59. Description of proposal:	**Site – Former Nuclear Power Station, Bradwell on Sea, Essex** **Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location

	to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of treated radioactive site drainage. The mixed effluent site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The maximum daily volume of this effluent will be 30 m3 because this is the maximum volume of the final delay tank. The pumps are manually controlled and discharges will only be made on one ebb tide per day between 1 and 2.5 hours after high water at a maximum rate of 11 litres per second which means it can all be discharged in 30 minutes, although it will probably be done over one hour. The new outlet is situated approximately 400 metres out into the estuary at the same location as the existing one but is 5.5 metres above the estuary bed. The 180 mm discharge pipe narrows to a nozzle of 65 mm and is at right angles to the main currents. This allows the maximum dispersion and dilution for the effluent. Because the discharge is rainfall dependent it will be intermittent and not continuous. The outlet for the effluent is the same one used for the FED effluent from the same site (as outlined on accompanying App 4) which is also likely to be intermittent. In the event that both discharges need to be made on the same day they will be made on different ebb tides. **Treatment and discharge quality** As stated above the source of this effluent is rainfall falling on those areas of the site that formerly housed the reactor. This is a smaller area than the non-radioactive areas so the volumes can be more easily controlled for treatment. Demolition during decommissioning has exposed crushed concrete to rainwaters which has led to highly alkaline waters sitting in voids leaching metals from dismantled

	structures and equipment. This alkaline water is collected and treated in an Aqueous Abatement plant with pH adjustment, ultra filtration absorption and ion exchange processes. The maximum concentrations of metals in the treated effluent are given in Table 1 below extracted from tables given in the application. They are based on samples taken when a particularly contaminated void on site was dewatered. This was a one-off exercise which will not be repeated. As such they are atypically high and represent a worst case scenario. **Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)**

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent(ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	10.9	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

60. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
61. Has there been any pre-application discussion or correspondence with SNCB?	NO

62. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Active Geomorphological	Saltmarsh Morphology - A geological feature.
Aggregations of breeding birds	Little Tern
Aggregations of breeding birds	Ringed Plover
Aggregations of non-breeding birds	Black-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Dunlin

Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Ringed Plover
Aggregations of non-breeding birds	Sanderling
Coastal	Quaternary Of The Thames - A geological feature.
Coastal vegetated shingle	Coastal vegetated shingle
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Outstanding Dragonfly Assemblage	Outstanding Dragonfly Assemblage
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand
Broad SAC	Sandbanks Which Are Slightly Covered By Sea All The Time

The mudflats, salt marshes and grazing marshes of the Colne estuary which form part of the internationally important wetland that supports and allows the overwintering of birds Brent Geese and Black Tailed Godwit and are important for breeding several species of waders and wildfowl. The invertebrates in these habitats which provide the food source for the birds. The salt marshes and intertidal muds of Mersea Flats and Colne point are the main areas that are theoretically susceptible to the influence of the discharge because they are closest to it

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge it will not pose a risk to <u>any</u> aquatic flora or fauna within the SSSI so that none of the designated species or habitats will be threatened by it.

<u>Key concepts in the assessment :-</u>

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010.

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being insignificant it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance.nes.

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals

The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only threat to the interest features of the SSSI from toxic effects. It can be seen from Table 1 above that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test. This uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screen out as being insignificant and not liable to cause pollution in the receiving waterbody. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified that the all the metals screened out as 'insignificant'. . In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.

There is further evidence that the concentrations of metals in this effluent will be insignificant however because although this discharge passed the H1 screening test the FED effluent from the same site did not and the applicant engaged consultants to undertake detailed dilution and dispersion modelling for this. These models are also applicable to the radioactive site drainage discharge because it is discharged from the same outlet at similar rates and at similar times on an ebb tide. The modelling predicts that within 100 metres of the discharge point this effluent will be subject to an absolute minimum dilution factor of 250:1 and a minimum 'average' dilution of 700:1. This is more than enough dilution to render all the metals in the discharge below there respective EQS concentrations. Unlike the FED effluent the site drainage effluent will be buoyant and will climb to the surface as it mixes so that no features on the sea bed could be affected even within the mixing zone.

For the above reasons we do not believe that the metals in the discharge would pose any risk to the features of the SSSI outside a limited mixing zone if we allowed the change to the new outlet structure.

Temperature

The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the features of the SSSI from the separation of the effluents and the use of the new outlet structure.

pH

The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is 250:1 minimum dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and because the effluent is buoyant it will not affect any shellfish on the estuary bed even within the mixing zone.

For this reason it could not have an adverse effect on any interest features of the Blackwater Estuary and definitely not on the Colne SSSI estuary over four kilometres across it

Turbidity and siltation

Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can have no effect on the interest features of the SSSI from turbidity or siltation effects even within the mixing zone.

Salinity

The discharge is non-saline and is far too small to have any influence on the existing background salinity regime within the Blackwater estuary, and could certainly not have any on the regime in the Colne estuary over 4 kilometres across it. Changing to a new outlet structure would not change this situation.

Physical Damage

The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,00 m3) to have any physical effect on the interest features of the Blackwater estuary and definitely none on the Colne estuary over 4 kilometres across it. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.

63. Decision

iv) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the treated radioactive site drainage their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to self–monitor, record and report the metals concentrations. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis.

64. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
65. Date form sent to SNCB:	**29/2/2016**
For Environment Agency use only, once SNCB response received	
66. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
67. Name and job title of SNCB officer:	
68. Date of receipt of SNCB response:	

(5) Crouch and Roach Estuaries SSSI – Non Radioactive site drainage

CRoW Appendix 4 (140_10_SD02) **CRoW Act 2000: Environment Agency application for permission - Formal Notice**	Environment Agency
Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB). Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000. Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).	

69. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
70. Name of SSSI:	Crouch and Roach Estuaries
71. Type of permission:	Environmental Permit – Water Discharge Activity
72. Date for Environment Agency permit determination:	**31/3/2016**
73. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3/2016**
74. Environment Agency reference no:	PR2TS/E10760C
75. National grid reference:	**TL 99650 09150** 
76. Description of proposal:	**Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void

	waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of clean surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry

	weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.' The new outlet for this discharge is in fact three small pipes of 180 mm diameter situated 3 metres above the seabed to prevent siltation. The effluents are all buoyant and will rise to the surface getting some initial dilution as they do so even in the lowest tides. With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment and is designed to achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammoniacal nitrogen. In dry weather it will receive a minimum of just over three times dilution in the other effluents before discharge but in wet weather the dilution will be much greater. Because of this and because of the massive dilution in the receiving estuary (average flow 106,300,000 m3) such a small volume of treated sewage has no potential to cause any adverse effects and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is potable water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range of metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower. Table 1 . Metals concentrations in mixed effluent discharge compared

	to EQS's **(Derived from Table 3 pg 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108)**

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	**3.88**	**0.6**
Copper	11.54	N/A	3.23	10.9
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

77. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
78. Has there been any pre-application discussion or correspondence with SNCB?	NO

79. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Aggregations of non-breeding birds	Bar-tailed Godwit
Aggregations of non-breeding birds	Black-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Golden Plover
Aggregations of non-breeding birds	Lapwing
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Shelduck
Aggregations of non-breeding birds	Shoveler
Ditches	Ditches
Invertebrate Assemblage	Mineral marsh and Open Water: Open Water On Disturbed Sediments
Invertebrate Assemblage	Permanent Wet Mire: Rich Fen
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh

Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand

The salt marsh and intertidal muds in the outer fringes of the estuaries that provide a contiguous wetland habitat with the Dengie and Foulness SSSI's that support a large range of waders and waterfowl which can overwinter there.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to any aquatic flora or fauna in the receiving estuary so that none of the species or features it was designated for will be threatened by it

Key concepts in the assessment :-

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance,
In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals
The residual concentrations of metals in the discharge as outlined in Table 1 above are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS.

It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year.

Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being 'insignificant'. In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this.

We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge will have any significant adverse effect on any of the interest features of the receiving Blackwater Estuary SSSI and definitely could have none on those of the remote Crouch and Roach Estuaries SSSI over 17 kilometres away with the enormous further potential dilution in between. If we granted a permit the influence of the discharge would be limited to a small mixing zone around the outlet and there would be no direct instantaneous toxic or long term chronic effect even within this.

Temperature
The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the estuary and changing to a new outlet will not make a difference.

pH
The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the interest features of any of the conservation sites in the vicinity or more remote from pH effects and that the change to the new outlets and discharge arrangements would make no difference.

Turbidity
The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non –reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the

mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and therefore not have any significant effect on the interest feature of the Crouch and Roach SSSI. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion.

Siltation
As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features even close to the discharge point. It could definitely have no impact on the features of the Crouch and Roach estuaries over 17 kilometres away. The prevailing background conditions there would not change with regards to siltation.

Salinity
None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the interest features of the SSSII.

Physical Damage
If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within any of the adjacent or remote SSSI's.The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation.

80. Decision

v) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the mixed effluents from their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent.

Permit Conditions

The permit will have a condition limiting the maximum daily volume in ' dry weather conditions' to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges.

The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped.

(*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*

81. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
82. Date form sent to SNCB:	**29/3/2016**
For Environment Agency use only, once SNCB response received	
83. SNCB comment on assessment:	*Please delete as appropriate:* i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
84. Name and job title of SNCB officer:	
85. Date of receipt of SNCB response:	

(6) Crouch and Roach Estuaries SSSI – Radioactive site drainage

CRoW Appendix 4 (140_10_SD02)

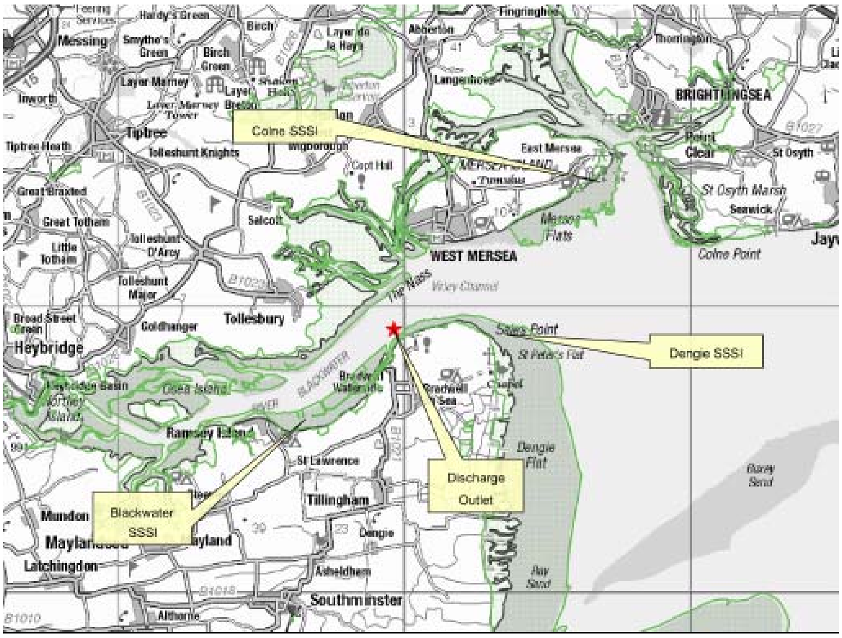
CRoW Act 2000: Environment Agency application for permission - Formal Notice

Environment Agency

Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB).

Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000.

Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).

86. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
87. Name of SSSI:	Crouch and Roach Estuaries
88. Type of permission:	Environmental Permit – Water Discharge Activity
89. Date for Environment Agency permit determination:	**31/3/2016**
90. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3/2016**
91. Environment Agency reference no:	PR2TS/E10760C
92. National grid reference:	**TL 99650 09150** 
93. Description of proposal:	**Site – Former Nuclear Power Station, Bradwell on Sea, Essex** **Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly

	housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of treated radioactive site drainage. The mixed effluent site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The maximum daily volume of this effluent will be 30 m3 because this is the maximum volume of the final delay tank. The pumps are manually controlled and discharges will only be made on one ebb tide per day between 1 and 2.5 hours after high water at a maximum rate of 11 litres per second which means it can all be discharged in 30 minutes, although it will probably be done over one hour. The new outlet is situated approximately 400 metres out into the estuary at the same location as the existing one but is 5.5 metres above the estuary bed. The 180 mm discharge pipe narrows to a nozzle of 65 mm and is at right angles to the main currents. This allows the maximum dispersion and dilution for the effluent. Because the discharge is rainfall dependent it will be intermittent and not continuous. The outlet for the effluent is the same one used for the FED effluent from the same site (as outlined on accompanying App 4) which is also likely to be intermittent. In the event that both discharges need to be made on the same day they will be made on different ebb tides.

	Treatment and discharge quality As stated above the source of this effluent is rainfall falling on those areas of the site that formerly housed the reactor. This is a smaller area than the non-radioactive areas so the volumes can be more easily controlled for treatment. Demolition during decommissioning has exposed crushed concrete to rainwaters which has led to highly alkaline waters sitting in voids leaching metals from dismantled structures and equipment. This alkaline water is collected and treated in an Aqueous Abatement plant with pH adjustment, ultra filtration absorption and ion exchange processes. The maximum concentrations of metals in the treated effluent are given in Table 1 below extracted from tables given in the application. They are based on samples taken when a particularly contaminated void on site was dewatered. This was a one-off exercise which will not be repeated. As such they are atypically high and represent a worst case scenario.
94. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
95. Has there been any pre-application discussion or correspondence with SNCB?	NO

Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent(ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	10.9	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

96. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:

List of features:

Broad Feature Description	Common Feature Description
Aggregations of non-breeding birds	Bar-tailed Godwit

Aggregations of non-breeding birds	Black-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Golden Plover
Aggregations of non-breeding birds	Lapwing
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Shelduck
Aggregations of non-breeding birds	Shoveler
Ditches	Ditches
Invertebrate Assemblage	Mineral marsh and Open Water: Open Water On Disturbed Sediments
Invertebrate Assemblage	Permanent Wet Mire: Rich Fen
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand

The salt marsh and intertidal muds in the outer fringes of the estuaries that provide a contiguous wetland habitat with the Dengie and Foulness SSSI's that support a large range of waders and waterfowl which can overwinter there.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge it will not pose a risk to any aquatic flora or fauna within the SSSI so that none of the designated species or habitats will be threatened by it.

Key concepts in the assessment :-

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales)

Directions 2010.

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being insignificant it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance.nes.

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals

The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only threat to the interest features of the SSSI from toxic effects. It can be seen from Table 1 above that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.

This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screen out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified that the all the metals screened out as 'insignificant'. . In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.

There is further evidence that the concentrations of metals in this effluent will be insignificant however because although this discharge passed the H1 screening test the FED effluent from the same site did not and the applicant engaged consultants to undertake detailed dilution and dispersion modelling for this. These models are also applicable to the radioactive site drainage discharge because it is discharged from the same outlet at similar rates and at similar times on an ebb tide. The modelling predicts that within 100 metres of the discharge point this effluent will be subject to am absolute minimum dilution factor of 250:1 and a minimum 'average' dilution of 700:1. This is more than enough dilution to render all the metals in the discharge below their respective EQS concentrations Unlike the FED effluent the site drainage effluent will be buoyant and will climb to the surface as it mixes so that no features on the sea bed could be affected even within the mixing zone.

Since the nearest part of the Crouch and Roach Estuaries SSSI is over 17 kilometres metres from the discharge point around the tip of the Dengie peninsular and away from the dispersion plume we are confident that it could have no effect on the interest features of the SSSI from its metals concentrations.

Temperature

The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the features of the SSSI from the separation of the effluents and the use of the new outlet structure and definitely none on the Crouch and Roach Estuaries over 17 Kilometres away.

pH

The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is 250:1 minimum dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7. Since the nearest part of the Crouch and Roach Estuaries SSSI to the discharge point is 17 kilometres away there is definitely no danger to its interest features from pH effects.

Turbidity and siltation

Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can have no effect on the interest features of the SSSI from turbidity or siltation effects,

Salinity

The discharge is non-saline and is far too small to have any influence on the existing background salinity regime within the Blackwater estuary. It can have no influence at all on the remote Crouch and Roach Estuaries SSSI. Changing to a new outlet structure would not change this situation.

Physical Damage

The discharge is far too small (30 m3) to have any affect on the physical flow regime in the habitats of the receiving Blackwater Estuary SSSI and can definitely not have any influence on those of the Crouch and Roach Estuaries over 17 kilometres away. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.

97. Decision

vi) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the treated radioactive site drainage their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis.

98. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
99. Date form sent to SNCB:	**29/2/2016**
For Environment Agency use only, once SNCB response received	
100. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
101. Name and job title of SNCB officer:	
102. Date of receipt of SNCB response:	

(7) The Dengie SSSI – Non Radioactive site drainage

CRoW Appendix 4 (140_10_SD02)

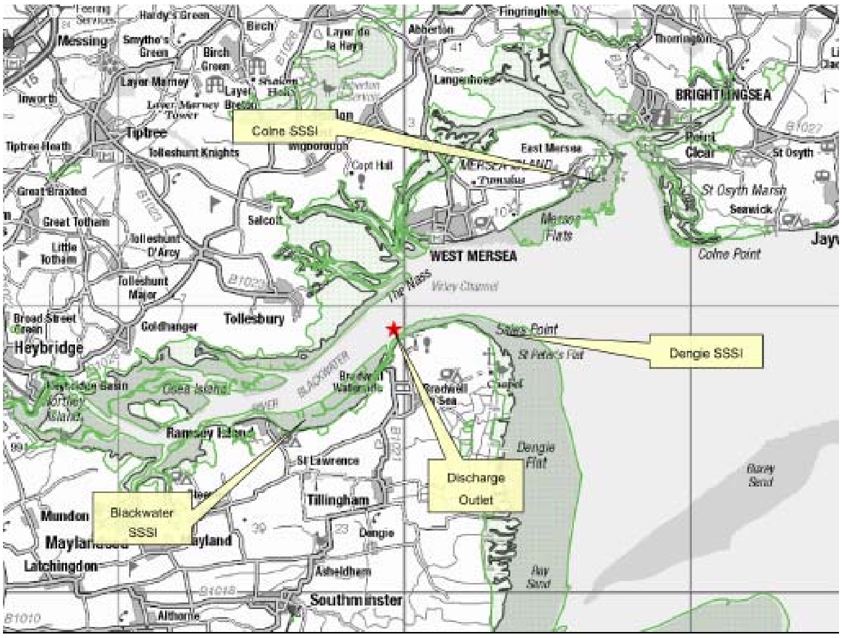
CRoW Act 2000: Environment Agency application for permission - Formal Notice

Environment Agency

Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB).

Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000.

Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).

103. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
104. Name of SSSI:	Dengie SSSI
105. Type of permission:	Environmental Permit – Water Discharge Activity
106. Date for Environment Agency permit determination:	**31/3//2016**
107. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3/2016**
108. Environment Agency reference no:	PR2TS/E10760C
109. National grid reference:	**TL 99650 09150** 
110. Description of proposal:	**Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly

	housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of clean surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a

factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.'

The new outlet for this discharge is in fact three small pipes of 180 mm diameter situated 3 metres above the seabed to prevent siltation. The effluents are all buoyant and will rise to the surface getting some initial dilution as they do so even in the lowest tides.

With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals.

The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment and is designed to achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen. In dry weather it will receive a minimum of just over three times dilution in the other effluents before discharge but in wet weather the dilution will be much greater. Because of this and because of the massive dilution in the receiving estuary (average flow 106,300,000 m3) such a small volume of treated sewage has no potential to cause any adverse effects and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one.

The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is potable water.

Treatment and discharge quality

The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it.

The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range of metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

Table 1 . Metals concentrations in mixed effluent discharge compared to EQS's

	(Derived from Table 3 pg 6 of Env Risk Assessment in Support of <u>Aqueous</u> Effluent BRAD/EN/REP/108)
111. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
112. Has there been any pre-application discussion or correspondence with SNCB?	NO

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	**3.88**	**0.6**
Copper	11.54	N/A	3.23	10.9
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

113. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Active Geomorphological	Saltmarsh Morphology - A geological feature.
Aggregations of breeding birds	Bearded Tit
Aggregations of breeding birds	Ringed Plover
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Knot
Aggregations of non-breeding birds	Ringed Plover
Aggregations of non-breeding birds	Turnstone
Coastal vegetated shingle	Coastal vegetated shingle
Nationally scarce plant	Lax-flowered Sea-lavender
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SPA	Hen Harrier
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)

Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand

The tidal mudflats and salt marshes with their abundant flora and fauna which support national and internationally important population of wildfowl and waders in winter and in summer support a range of breeding coastal birds some of which are rare. The invertebrates of the foreshore mudflats including molluscs, marine worms and crustacea and vegetation including algal species and eel grasses. The areas of the SSSI adjacent to the Blackwater Estuary SSSI around the tip of the Dengie peninsula are theoretically most susceptible to any potential polluting affects of the discharge because they are the closest to it.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge it will not pose a risk to any aquatic flora or fauna within the SSSI so that none of the designated species or habitats will be threatened by it.

Key concepts in the assessment :-

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance,

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals
The residual concentrations of metals in the discharge as outlined in Table 1 above are the only potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium.. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS.

It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year.

Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium concentration in this discharge screened out as being 'insignificant'. Insignificant in H! assessment terms means that it could have no short term or long term adverse toxic effect on any aquatic organism and cause no breaches of WFD targets in the receiving waterbody.

Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet. We are therefore confident that if we allowed the discharge to be made from the new outlet no harm would be caused to the interest features of the Dengie SSSI the closet of which are approximately 400 metres from the discharge point.

Temperature

The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects on the features of the Dengie SSSI.

pH
The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that changing the outlet structure for the mixed effluent discharge could have no significant adverse effects on the interest features of the Dengie SSSI.

Turbidity
The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non –reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary and therefore no adverse effect on the interest features of the Dengie SSSI on its fringes.

Siltation
As stated above the suspended solids concentrations in the combined effluents are within the average range for the

receiving estuary but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into 106,300,000 m3 of estuary with a background of 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to any interest features of the Dengie SSSI that are close to it.

Salinity
None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the Blackwater estuary. Changing the outlet structure and discharge arrangements will not make a difference and can therefore have no adverse affect on the interest features of the Dengie SSSI.

Physical Damage
If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any physical damage to the Blackwater estuary bed and could have no affect on the flow regime or physical features of the Dengie SSSI on its fringes.

The absolute maximum of discharge permitted would be reduced from the current 500,000 m3 a day to 55,000 m3 a day so any potential for physical damage would be reduced from the current situation.

114. Decision

vii) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the mixed effluents from the their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent.

Permit Conditions

The permit will have a condition limiting the maximum daily volume in ' dry weather conditions' to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges.

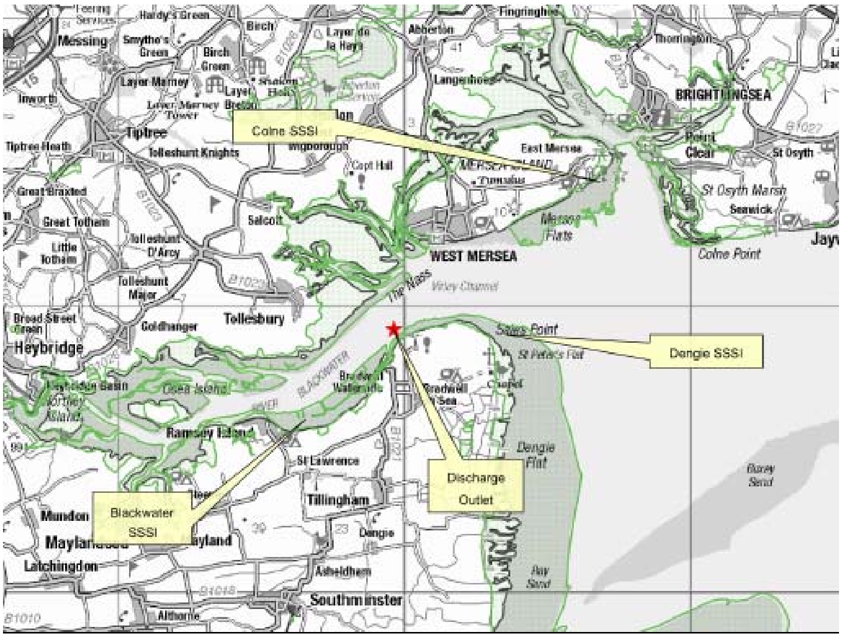
The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and

report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*

115. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
116. Date form sent to SNCB:	**29/2/2016**
For Environment Agency use only, once SNCB response received	
117. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
118. Name and job title of SNCB officer:	
119. Date of receipt of SNCB response:	

(8) The Dengie SSSI – Radioactive site drainage

CRoW Appendix 4 (140_10_SD02) **CRoW Act 2000: Environment Agency application for permission - Formal Notice**	Environment Agency
Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB). Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000. Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).	
120. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
121. Name of SSSI:	Dengie SSSI
122. Type of permission:	Environmental Permit – Water Discharge Activity
123. Date for Environment Agency permit determination:	**31/3/2016**

124. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3/2016**
125. Environment Agency reference no:	PR2TS/E10760C
126. National grid reference:	**TL 99650 09150** 
127. Description of proposal:	**Site – Former Nuclear Power Station, Bradwell on Sea, Essex** **Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location

	to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of treated radioactive site drainage. The mixed effluent site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The maximum daily volume of this effluent will be 30 m3 because this is the maximum volume of the final delay tank. The pumps are manually controlled and discharges will only be made on one ebb tide per day between 1 and 2.5 hours after high water at a maximum rate of 11 litres per second which means it can all be discharged in 30 minutes, although it will probably be done over one hour. The new outlet is situated approximately 400 metres out into the estuary at the same location as the existing one but is 5.5 metres above the estuary bed. The 180 mm discharge pipe narrows to a nozzle of 65 mm and is at right angles to the main currents. This allows the maximum dispersion and dilution for the effluent. Because the discharge is rainfall dependent it will be intermittent and not continuous. The outlet for the effluent is the same one used for the FED effluent from the same site (as outlined on accompanying App 4) which is also likely to be intermittent. In the event that both discharges need to be made on the same day they will be made on different ebb tides. **Treatment and discharge quality** As stated above the source of this effluent is rainfall falling on those areas of the site that formerly housed the reactor. This is a smaller area than the non-radioactive areas so the volumes can be more easily controlled for treatment. Demolition during decommissioning has exposed crushed concrete to rainwaters which has led to highly alkaline waters sitting in voids leaching metals from dismantled

	structures and equipment. This alkaline water is collected and treated in an Aqueous Abatement plant with pH adjustment, ultra filtration absorption and ion exchange processes. The maximum concentrations of metals in the treated effluent are given in Table 1 below extracted from tables given in the application. They are based on samples taken when a particularly contaminated void on site was dewatered. This was a one-off exercise which will not be repeated. As such they are atypically high and represent a worst case scenario. **Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)**

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent(ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	10.9	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

128. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
129. Has there been any pre-application discussion or correspondence with SNCB?	NO

130. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Active Geomorphological	Saltmarsh Morphology - A geological feature.
Aggregations of breeding birds	Bearded Tit
Aggregations of breeding birds	Ringed Plover
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Grey Plover

Aggregations of non-breeding birds	Knot
Aggregations of non-breeding birds	Ringed Plover
Aggregations of non-breeding birds	Turnstone
Coastal vegetated shingle	Coastal vegetated shingle
Nationally scarce plant	Lax-flowered Sea-lavender
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SPA	Hen Harrier
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand

The tidal mudflats and salt marshes with their abundant flora and fauna which support national and internationally important population of wildfowl and waders in winter and in summer support a range of breeding coastal birds some of which are rare. The invertebrates of the foreshore mudflats including molluscs, marine worms and crustacea and vegetation including algal species and eel grasses. The areas of the SSSI adjacent to the Blackwater Estuary SSSI around the tip of the Dengie peninsula are theoretically most susceptible to any potential polluting affects of the discharge because they are the closest to it.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge it will not pose a risk to <u>any</u> aquatic flora or fauna within the SSSI so that none of the designated species or habitats will be threatened by it.

<u>Key concepts in the assessment :-</u>

Environmental Quality Standards (EQS’s)

EQS’s are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS’s of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS’s we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010.

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS’s) can be achieved within the discharge. EQS’s are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS’s before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being insignificant it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance.nes.

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals

The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only threat to the interest features of the SSSI from toxic effects. It can be seen from Table 1 above that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.

This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screen out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified that the all the metals screened out as 'insignificant'. . In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.

There is further evidence that the concentrations of metals in this effluent will be insignificant however because although this discharge passed the H1 screening test the FED effluent from the same site did not and the applicant engaged consultants to undertake detailed dilution and dispersion modelling for this. These models are also applicable to the radioactive site drainage discharge because it is discharged from the same outlet at similar rates and at similar times on an ebb tide. The modelling predicts that within 100 metres of the discharge point this effluent will be subject to an absolute minimum dilution factor of 250:1 and a minimum 'average' dilution of 700:1. This is more than enough dilution to render all the metals in the discharge below their respective EQS concentrations. Unlike the FED effluent the site drainage effluent will be buoyant and will climb to the surface as it mixes so that no features on the sea bed could be affected even within the mixing zone.

Since the nearest part of the Dengie SSSI is over 400 metres from the discharge point we are confident that it could have no effect on the interest features of the SSSI from its metals concentrations.

Temperature

The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the features of the SSSI from the separation of the effluents and the use of the new outlet structure.

pH

The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is 250:1 minimum dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7. Since the nearest part of the Dengie SSSI to the discharge point is over four hundred metres away there is no danger to its interest features from pH effects.

Turbidity and siltation

Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can have no effect on the interest features of the SSSI from turbidity or siltation effects,

Salinity

The discharge is non-saline and is far too small to have any influence on the existing background salinity regime within the Blackwater estuary including the habitats of the Dengie SSSI on its eastern fringes. Changing to a new outlet structure would not change this situation.

Physical Damage

The discharge is far too small (30 m3) to have any affect on the physical flow regime in the habitats of the Dengie SSSI over four hundred metres away. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.

131. Decision

viii) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the treated radioactive site drainage their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis.

132. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
133. Date form sent to SNCB:	**29/3/2016**
For Environment Agency use only, once SNCB response received	
134. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
135. Name and job title of SNCB officer:	
136. Date of receipt of SNCB response:	

(9) Foulness SSSI – Non Radioactive site drainage

CRoW Appendix 4 (140_10_SD02) **CRoW Act 2000: Environment Agency application for permission - Formal Notice**	Environment Agency
Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB). Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000. Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).	
137. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
138. Name of SSSI:	Foulness
139. Type of permission:	Environmental Permit – Water Discharge Activity
140. Date for Environment Agency permit determination:	**31/3//2016**

141. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3//2016**
142. Environment Agency reference no:	PR2TS/E10760C
143. National grid reference:	**TL 99650 09150** 
144. Description of proposal:	**Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an

	ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of clean surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.' The new outlet for this discharge is in fact three small pipes of 180 mm diameter situated 3 metres above the seabed to prevent siltation. The effluents are all buoyant and will rise to the surface getting some initial dilution as they do so even in the lowest tides.

With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals.

The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment and is designed to achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen. In dry weather it will receive a minimum of just over three times dilution in the other effluents before discharge but in wet weather the dilution will be much greater. Because of this and because of the massive dilution in the receiving estuary (average flow 106,300,000 m3) such a small volume of treated sewage has no potential to cause any adverse effects and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one.

The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the ‘trade effluent derived from water treatment’ component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is potable water.

Treatment and discharge quality
The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it.

The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range of metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS’s. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

Table 1 . Metals concentrations in mixed effluent discharge compared to EQS’s

(Derived from Table 3 pg 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108)

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)

Chromium	6.77	32	**3.88**	**0.6**
Copper	11.54	N/A	3.23	10.9
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

145. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
146. Has there been any pre-application discussion or correspondence with SNCB?	NO

147. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:
List of features:

Broad Feature Description	Common Feature Description
Aggregations of breeding birds	Avocet
Aggregations of breeding birds	Common Tern
Aggregations of breeding birds	Little Tern
Aggregations of breeding birds	Ringed Plover
Aggregations of breeding birds	Sandwich Tern
Aggregations of non-breeding birds	Avocet
Aggregations of non-breeding birds	Bar-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Curlew
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Knot
Aggregations of non-breeding birds	Oystercatcher
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Shelduck
Coastal vegetated shingle	Coastal vegetated shingle
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Population of Schedule 8 plant	Pedunculate Sea-purslane
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage

Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand
Broad SAC	Sandbanks Which Are Slightly Covered By Sea All The Time

The intertidal sand-silt flats and saltmarshes of the northern section of Foulness which forms a contiguous wetland habitat with the Dengie and Crouch and Roach SSSIs and are of national and international importance as winter feeding grounds for nine species of wildfowl and waders.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the receiving estuary so that none of the species or features it was designated for will be threatened by it

<u>Key concepts in the assessment :-</u>

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance,
In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals
The residual concentrations of metals in the discharge as outlined in Table 1 above are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium.. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS.

It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year.

Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being ‘insignificant’. In H1 terms ‘insignificant’ means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this.

We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge will have any significant adverse effect on any of the interest features of the receiving Blackwater estuary SSSI and therefore definitely none on the features of the more distant Foulness SSSI over 15 kilometres away. If we granted a permit the influence of the discharge would be limited to a small mixing zone around the outlet and there would be no direct instantaneous toxic or long term chronic effect even within this.

Temperature
The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents can not have any adverse temperature effects within the receiving Blackwater estuary and definitely none on the features of the Foulness over 15 kilometres away. Changing to a new outlet will not make a difference.

pH
The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the interest features of Blackwater Estuary SSSI and definitely none on SSSI’s beyond it from pH effects. The change to a new outlet structure would make not difference to this conclusion. .

Turbidity
The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non –reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency’s Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the

mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge.

For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond it. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion.

Siltation
As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions even within a close vicinity of the discharge would not change with regards to siltation. We can therefore be very confident that there would be no adverse affect on the features of the Foulness SSSI over 15 kilometres away from the discharge from the new outlet..

Salinity
None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the interest features of the SSSI.

Physical Damage
If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within any of the adjacent or remote SSSI's.The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation.

148. Decision

ix) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the mixed effluents from the their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent.

Permit Conditions

The permit will have a condition limiting the maximum daily volume in ‘ dry weather conditions’ to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved

Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges.

The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped.

(*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*

149. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
150. Date form sent to SNCB:	**29/3/2016**
For Environment Agency use only, once SNCB response received	
151. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
152. Name and job title of SNCB officer:	
153. Date of receipt of SNCB response:	

(10) Foulness SSSI – Radioactive site drainage

CRoW Appendix 4 (140_10_SD02)

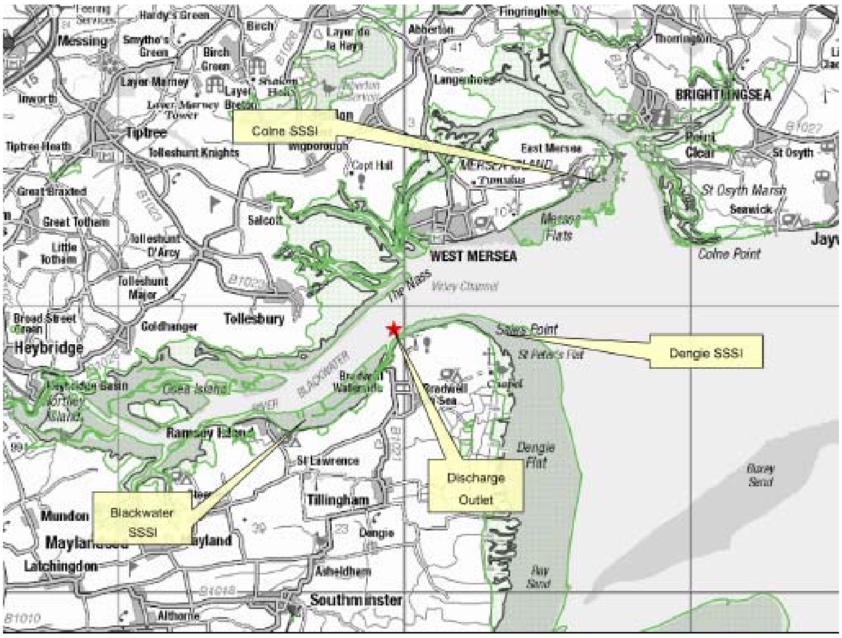
CRoW Act 2000: Environment Agency application for permission - Formal Notice

Environment Agency

Environment Agency Formal Notice to Statutory Nature Conservation Body (SNCB).

Requirements of Section 28I of the Wildlife & Countryside Act 1981 as amended by the Countryside and Rights of Way Act (CRoW) 2000.

Duty in relation to granting any consent, licence or permit for activities likely to damage Sites of Special Scientific Interest (SSSI).

154. Environment Agency area/NPS hub:	Essex, Norfolk and Suffolk area of Anglian Region Nottingham hub of National Permitting Service
155. Name of SSSI:	Foulness
156. Type of permission:	Environmental Permit – Water Discharge Activity
157. Date for Environment Agency permit determination:	**31/3/2016**
158. Predicted 28 day date for SNCB response (under S28 I(4)):	**28/3/2016**
159. Environment Agency reference no:	PR2TS/E10760C
160. National grid reference:	**TL 99650 09150** 
161. Description of proposal:	**Site – Former Nuclear Power Station, Bradwell on Sea, Essex** **Brief Description of Proposal** Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of

	treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore :- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be :- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of treated radioactive site drainage. The mixed effluent site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The maximum daily volume of this effluent will be 30 m3 because this is the maximum volume of the final delay tank. The pumps are manually controlled and discharges will only be made on one ebb tide per day between 1 and 2.5 hours after high water at a maximum rate of 11 litres per second which means it can all be discharged in 30 minutes, although it will probably be done over one hour. The new outlet is situated approximately 400 metres out into the estuary at the same location as the existing one but is 5.5 metres above the estuary bed. The 180 mm discharge pipe narrows to a nozzle of 65 mm and is at right angles to the main currents. This allows the maximum dispersion and dilution for the effluent. Because the discharge is rainfall dependent it will be intermittent and not continuous. The outlet for the effluent is the same one used for the FED effluent from the same site (as outlined on accompanying App 4) which is also likely to be intermittent. In the event that both discharges need to be made on the same day they will be made on

	different ebb tides. **Treatment and discharge quality** As stated above the source of this effluent is rainfall falling on those areas of the site that formerly housed the reactor. This is a smaller area than the non-radioactive areas so the volumes can be more easily controlled for treatment. Demolition during decommissioning has exposed crushed concrete to rainwaters which has led to highly alkaline waters sitting in voids leaching metals from dismantled structures and equipment. This alkaline water is collected and treated in an Aqueous Abatement plant with pH adjustment, ultra filtration absorption and ion exchange processes. The maximum concentrations of metals in the treated effluent are given in Table 1 below extracted from tables given in the application. They are based on samples taken when a particularly contaminated void on site was dewatered. This was a one-off exercise which will not be repeated. As such they are atypically high and represent a worst case scenario. **Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)**

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent(ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	10.9	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

162. Is the proposed activity within (wholly or partially) the SSSI boundary?	NO
163. Has there been any pre-application discussion or correspondence with SNCB?	NO

164. What aspect(s) of the proposed permission may damage the features which are of special interest for the SSSI?

The following 'Operations Requiring Consent' (or other activities associated with the permission) that may cause damage) are relevant to the proposed permission:

Dumping or spreading or discharge of any material

Features which are of special interest and may be affected by this activity:

List of features:

Broad Feature Description	Common Feature Description
Aggregations of breeding birds	Avocet
Aggregations of breeding birds	Common Tern
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Aggregations of breeding birds	Ringed Plover
Aggregations of breeding birds	Sandwich Tern
Aggregations of non-breeding birds	Avocet
Aggregations of non-breeding birds	Bar-tailed Godwit
Aggregations of non-breeding birds	Brent Goose (Dark-bellied)
Aggregations of non-breeding birds	Curlew
Aggregations of non-breeding birds	Dunlin
Aggregations of non-breeding birds	Grey Plover
Aggregations of non-breeding birds	Knot
Aggregations of non-breeding birds	Oystercatcher
Aggregations of non-breeding birds	Redshank
Aggregations of non-breeding birds	Shelduck
Coastal vegetated shingle	Coastal vegetated shingle
Invertebrate Assemblage	Saltmarsh, Estuary And Mudflat: Saltmarsh And Transitional Brackish Marsh
Population of Schedule 8 plant	Pedunculate Sea-purslane
Saltmarsh	Saltmarsh
Vascular Plant Assemblage	Vascular Plant Assemblage
Broad SAC	Atlantic Salt Meadows (Glauco-Puccinellietalia Maritimae)
Broad SAC	Cordgrass Swards
Broad SAC	Estuaries
Broad SAC	Intertidal Mudflats And Sandflats
Broad SAC	Mediterranean Saltmarsh Scrubs
Broad SAC	Salicornia And Other Annuals Colonising Mud And Sand
Broad SAC	Sandbanks Which Are Slightly Covered By Sea All The Time

The intertidal sand-silt flats and saltmarshes of the northern section of Foulness which forms a contiguous wetland habitat with the Dengie and Crouch and Roach SSSIs and are of national and international importance as winter feeding grounds for nine species of wildfowl and waders.

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge it will not pose a risk to any aquatic flora or fauna within the SSSI so that none of the designated species or habitats will be threatened by it.

Key concepts in the assessment :-

Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010.

Acceptable Mixing Zones

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Basically there are successive screening phases and if the concentrations of each substance do not screen out as being insignificant it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance.nes.

In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

Potential Toxic Effects

Metals

The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only threat to the interest features of the SSSI from toxic effects. It can be seen from Table 1 above that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.

This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screen out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified that the all the metals screened out as 'insignificant'. . In H1 terms 'insignificant' means that it could not have a toxic effect on any aquatic organism and could not cause a breach of any WFD target or class boundary Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.

There is further evidence that the concentrations of metals in this effluent will be insignificant however because although this discharge passed the H1 screening test the FED effluent from the same site did not and the applicant engaged consultants to undertake detailed dilution and dispersion modelling for this. These models are also applicable to the radioactive site drainage discharge because it is discharged from the same outlet at similar rates and at similar times on an ebb tide. The modelling predicts that within 100 metres of the discharge point this effluent will be subject to an absolute minimum dilution factor of 250:1 and an 'average' minimum dilution factor of 700:1. This is more than enough dilution to render all the metals in the discharge below EQS concentrations.

Unlike the FED effluent the site drainage effluent will be buoyant and will climb to the surface as it mixes so that no features on the sea bed could be affected even within the mixing zone.

Since the nearest part of the Foulness SSSI is over 15 kilometres metres from the discharge point around the tip of the Dengie peninsular and away from the dispersion plume we are confident that it could have no effect on the interest features of the SSSI from its metals concentrations.

Temperature

The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the features of the SSSI from the separation of the effluents and the use of the new outlet structure and definitely none on the features of the Foulness SSSI over 15 Kilometres away.

pH

The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is 250:1 minimum dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7. Since the nearest part of the Foulness SSSI to the discharge point is over 15 kilometres away there is definitely no danger to its interest features from pH effects.

Turbidity and siltation

Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can have no effect on the interest features of the SSSI from turbidity or siltation effects,

Salinity

The discharge is non-saline and is far too small to have any influence on the existing background salinity regime within the Blackwater estuary. It can have no influence at all on the salinity regime of the remote Foulness SSSI. Changing to a new outlet structure would not change this situation.

Physical Damage

The discharge is far too small (30 m3) to have any affect on the physical flow regime in the habitats of the receiving Blackwater Estuary SSSI and can definitely no have any influence on those of the Foulness SSSI over 15 kilometres away. Changing to the new outlet could not this. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.

165. Decision

x) The proposed permission is **not likely to damage** any of the flora, fauna or physiological features which are of special interest.

For the reasons given above we do not believe that allowing the applicant to discharge the treated radioactive site drainage their new outlet structure when it become necessary would pose any risk to the interest features and species for which the SSSI is designated.

The Environment Agency is minded to:

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped

Your agreement to granting the variation is sought on this basis.

166. Name and job title of Environment Agency officer:	**Bill Greenwood .** Permitting Officer
167. Date form sent to SNCB:	**29/3/ 2016**
For Environment Agency use only, once SNCB response received	
168. SNCB comment on assessment:	i) SNCB advise the operation can go ahead ii) SNCB advise the operation can go ahead with conditions iii) SNCB advise against permitting the operation Please ensure that SNCB response is attached to this Formal Notice.
169. Name and job title of SNCB officer:	
170. Date of receipt of SNCB response:	

(11) Blackwater Estuary (Mid Essex Coast Phase 1) SPA and Ramsar site – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)

Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:-

	• A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.' With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before

	discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300,000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the ‘trade effluent derived from water treatment’ component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is tap water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 (Located at the end of the document) shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS’s. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.
European site names and status:	**Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar** **Blackwater Estuary (Mid-Essex Coast Phase 4) SPA (or proposed SPA)**

List of interest features (relevant to this type of permission):	Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates 3.4 Birds of lowland wet grasslands (Black-tailed godwit (3.4), Brent goose (3.4), Dunlin (3.4), Grey plover (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Black-tailed godwit (3.8), Brent goose (3.8), Dunlin (3.8), Grey plover (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Brent goose (3.9), Dunlin (3.9), Grey plover (3.9), Waterfowl(>20, 000) (3.9)) Blackwater Estuary (Mid-Essex Coast Phase 4) SPA 3.10 Birds of open sea and offshore rocks (Little tern (3.10) 3.4 Birds of lowland wet grasslands (Brent goose (3.4) 3.6 Birds of lowland freshwaters and their margins (Pochard (3.6), (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Pochard (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Dunlin (3.9), Grey plover (3.9), Hen harrier (3.9), Pochard (3.9), Ringed plover (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:

1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Black-tailed godwit (3.4), Brent goose (3.4), Dunlin (3.4), Grey plover (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Black-tailed godwit (3.8), Brent goose (3.8), Dunlin (3.8), Grey plover (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Brent goose (3.9), Dunlin (3.9), Grey plover (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.10 Birds of open sea and offshore rocks (Little tern (3.10))	Toxic contamination	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Pochard (3.6), Waterfowl(>20, 000)).	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below

	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Pochard (3.8), Waterfowl(>20, 000)).	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Dunlin (3.9), Grey plover (3.9), Hen harrier (3.9), Pochard (3.9), Ringed plover (3.9), Waterfowl(>20, 000)).	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?	
Alone?	**No** **Key Principles of the assessment** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to any aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the effluent are too low to be harmful to bird species. The only potential for a

harmful affect on the designated bird species is ‘indirect’ by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to the designated bird species.

- Environmental Quality Standards (EQS’s)

EQS’s are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS..

We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS’s we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010.

- Acceptable Mixing Zones and the H1 screening tool

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS’s) can be achieved within the discharge. EQS’s are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS’s before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.

The Agency’s published guidance document ‘ *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges’*, incorporates the concept of mixing zones and EQS’s and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are

	successive screening phases and if the concentrations of each substance do not screen out as being ‘insignificant’ it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS’s and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. **Toxic effects - metals** The residual concentrations of metals in the discharge as outlined in Table 1 are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS. It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year. Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being ‘insignificant’. In H1 terms ‘insignificant’ means that it could not breach an EQS to have a toxic effect on any aquatic organism and could not cause a breach of any Water Framework Directive (WFD) target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this. We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge could not have any

	significant adverse effect on any aquatic flora or fauna outside a limited mixing zone around the discharge point. Because the effluent is buoyant there could be no effect at all on any species inhabiting the bed of the estuary. We are therefore confident that if we allowed the discharge there would be no indirect adverse affect on the designated bird species of the European site by a toxic affect on the species that form part of their habitat or are their food source **Temperature** The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the European site. Changing to a new outlet would not make a difference. **pH** The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the designated birds of the European site from pH effects and that the change to the new outlets and discharge arrangements would make no difference. **Turbidity** The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average volume 106,300,000 m3) is also huge. For these reasons we believe that the

	turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and therefore could not have any significant adverse affects on the designated bird species of the European site. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion. **Siltation** As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into an average volume of 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation and there would be no threat to the habitat of the designated bird species of the European site. **Salinity** None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the designated bird species of the European site. **Physical Damage** If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the European site. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation.

	For all the reasons given above we believe that allowing the changes to the permit that the applicant has requested for will have no significant adverse affect on the designated species of the European site.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: i) **No Likely Significant Effect** - this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licencing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of a day of treated radioactive site drainage. The only possible potential for significant 'in combination' affects from the three Magnox effluents on the European site are from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. Except for arsenic all the metals listed in Table 1, are also in discharges (a) and (b). The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension, or removal of, the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed. **The Environment Agency is minded to:**

	Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent and that ensure no significant adverse affect on the designated species Permit Conditions The permit will have a condition limiting the maximum daily volume in 'dry weather conditions' to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*	
EA Officer:	Bill Greenwood	**Date: 26/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B Suggested scope of the EA appropriate assessment:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Blackwater Estuary SPA/ Ramsar highlighted.

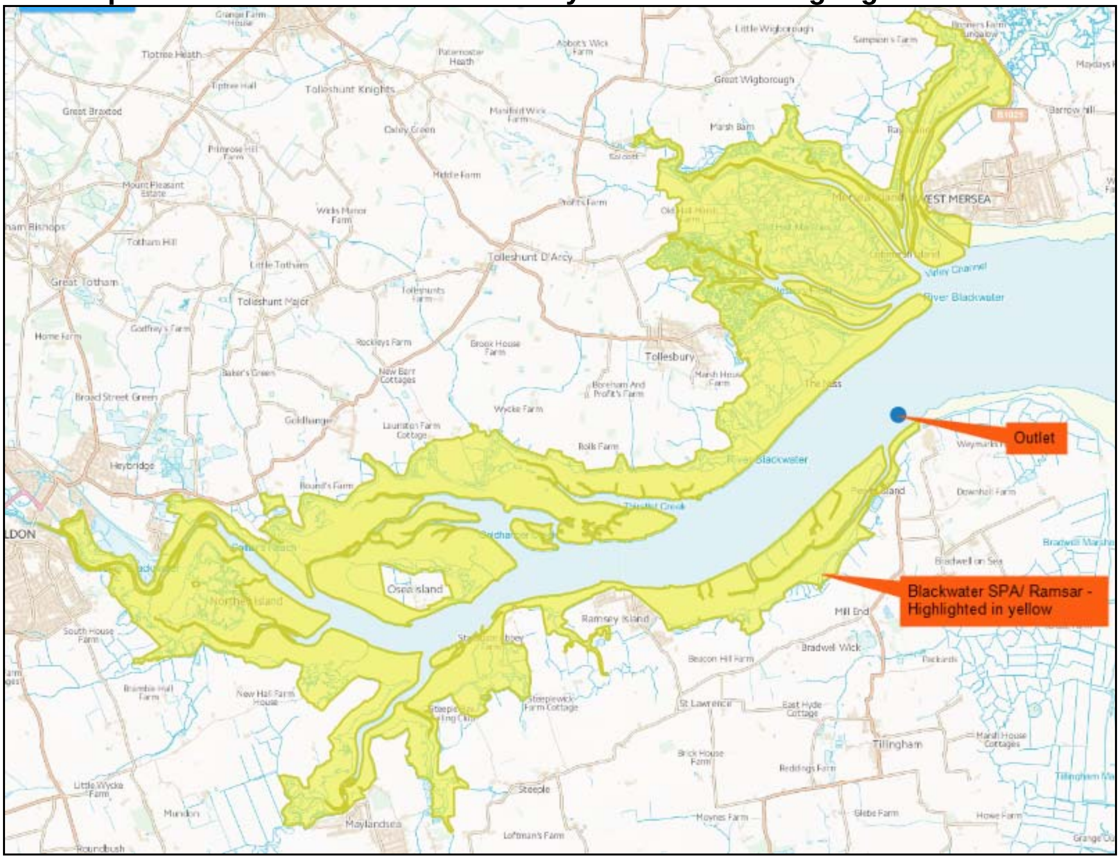

Table 1 - Metals concentrations in mixed effluent discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Derived from Table 3, page 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108.

(12) Blackwater Estuary (Mid Essex Coast Phase 1) SPA and Ramsar site - Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change

	the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licenced under a different permit, no EPR/ZP3493SQ The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an 'aqueous abatement plant'. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 (located at the end of the document) outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS's. The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become

	blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.
European site names and status:	**Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar** **Blackwater Estuary (Mid-Essex Coast Phase 4) SPA (or proposed SPA)**
List of interest features (relevant to this type of permission):	Blackwater Estuary (Mid-Essex Coast Phase 4) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Black-tailed godwit (3.4), Brent goose (3.4), Dunlin (3.4), Grey plover (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Black-tailed godwit (3.8), Brent goose (3.8), Dunlin (3.8), Grey plover (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Brent goose (3.9), Dunlin (3.9), Grey plover (3.9), Waterfowl(>20, 000) (3.9)) Blackwater Estuary (Mid-Essex Coast Phase 4) SPA 3.10 Birds of open sea and offshore rocks (Little tern (3.10) 3.4 Birds of lowland wet grasslands (Brent goose (3.4) 3.6 Birds of lowland freshwaters and their margins (Pochard (3.6), Waterfowl(>20, 000) (3.6)) 3.8 Birds of coastal habitats (Pochard (3.8), Waterfowl(>20, 000) (3.8)) 3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Dunlin (3.9), Grey plover (3.9), Hen harrier (3.9), Pochard (3.9), Ringed plover (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No
What potential hazards are likely to affect the interest features (relevant to this type of permission?	

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:

1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Black-tailed godwit (3.4), Brent goose (3.4), Dunlin (3.4), Grey plover (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Black-tailed godwit (3.8), Brent goose (3.8), Dunlin (3.8), Grey plover (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Brent goose (3.9), Dunlin (3.9), Grey plover (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.10 Birds of open sea and offshore rocks (Little tern (3.10))	Toxic contamination	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Pochard (3.6), Waterfowl(>20, 000)).	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below

	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Pochard (3.8), Waterfowl(>20, 000)).	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Black-tailed godwit (3.9), Dunlin (3.9), Grey plover (3.9), Hen harrier (3.9), Pochard (3.9), Ringed plover (3.9), Waterfowl(>20, 000)).	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?	**No** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the undiluted effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is 'indirect' by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be

	certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to birds. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of

	substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. • Modelling in support of the application Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1. **Toxic effects - Metals** The residual concentrations of metals in the discharge (as outlined in Table 1) are the only potential threat to the interest features of the SSSI from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test. This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet. In this case the dilution factors predicted by the modelling

	give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more than sufficient to prevent any breach of EQS's outside the mixing zone. We are therefore very confident that the metals in the discharge could have no significant adverse impact on any aquatic organisms outside a limited mixing zone. They could therefore have no affect on the designated bird species by diminishing their habitat or food sources. **Temperature** The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the designated bird species of the European sites or their habitat from the separation of the effluents and the use of the new outlet structure. **pH** The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the designated bird species of the European site or their habitat outside it. **Turbidity and siltation** Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can therefore have no effect on the designated species of the European site or their habitat. **Salinity** The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary. Changing to a new outlet structure will not change this situation. **Physical Damage** The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,00 m3) to have any physical effect on the interest features of the receiving

	Blackwater Estuary. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: ii) **No Likely Significant Effect** - this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licencing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration. The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. The metals listed in Table 1 are also in the FED effluent and discharge (b) also contains traces of chromium, copper, lead, nickel and zinc The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed.

	The Environment Agency is minded to: **Issue the permission with conditions to ensure no significant adverse affect on the designated species of the European sitel** Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents. Permit Conditions The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge. The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped. **Your agreement to granting the variation is sought on this basis.**	
EA Officer:	Bill Greenwood	**Date: 26/3/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Blackwater Estuary SPA/ Ramsar highlighted.

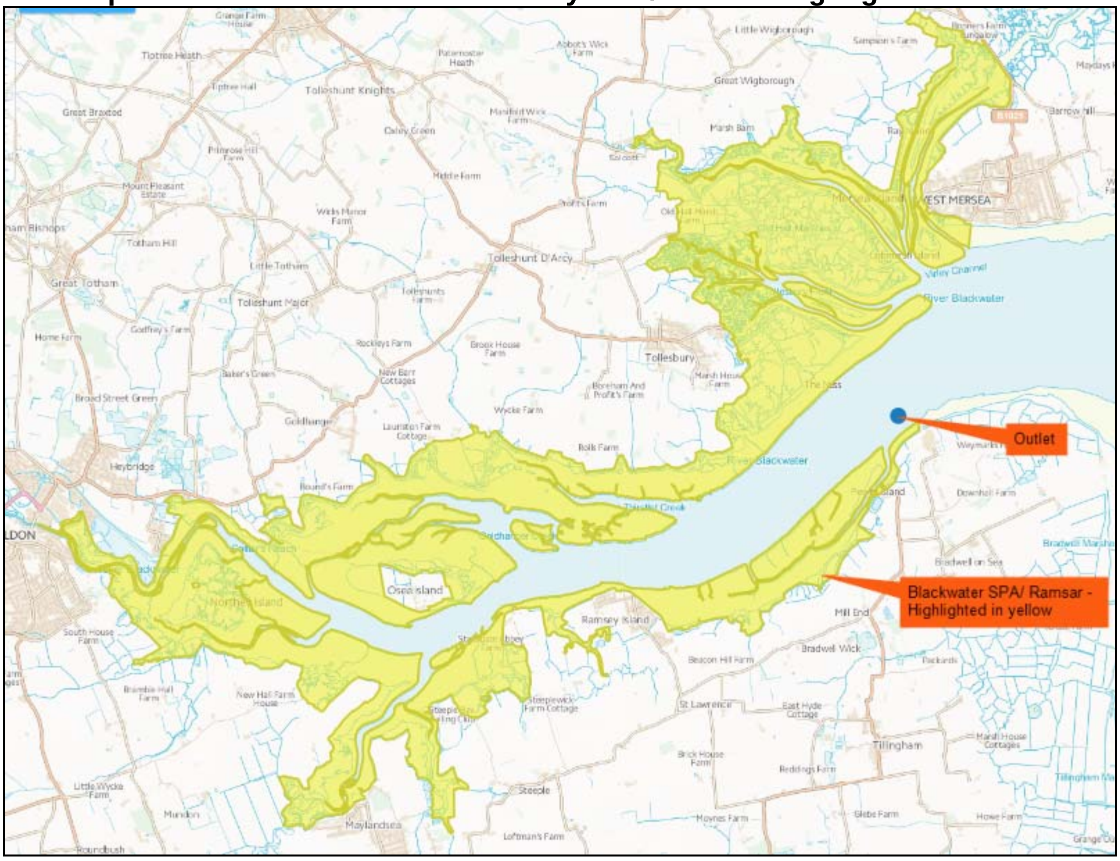

Table 1 - Metals concentrations in the treated radioactive site drainage effluent

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Extracts from Table 3 page 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 page 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108.

(13) Colne Estuary (Mid Essex Coast Phase 2) SPA and Ramsar site – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the

	effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this ‘worst case scenario’ discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as ‘130 m3 in dry weather conditions.’

	With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300,000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is tap water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 (Located at the end of the document) shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

European site names and status:	**Colne Estuary (Mid-Essex Coast Phase 2) Ramsar** **Colne Estuary (Mid Essex Coast Phase 3) SPA (or proposed SPA)**
List of interest features (relevant to this type of permission):	Colne Estuary (Mid Essex Coast Phase 3) SPA 3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Little tern (3.8), Pochard (3.8), Redshank (3.8), Ringed plover (3.8), Seabirds (>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Little tern (3.9), Pochard (3.9), Redshank (3.9), Ringed plover (3.9), Seabirds (>20, 000) (3.9)) Colne Estuary (Mid-Essex Coast Phase 2) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Redshank (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Redshank (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Redshank (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	**Potential hazard:**	**Potential exposure to hazard and mechanism of effect/impact if known:**

3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Little tern (3.8), Pochard (3.8), Redshank (3.8), Ringed plover (3.8), Seabirds (>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Little tern (3.9), Pochard (3.9), Redshank (3.9), Ringed plover (3.9), Seabirds (>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4), Redshank (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
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	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
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	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?	**No**

Key Principles of the assessment

We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion.

Key Principles of the assessment

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Any potential effect is further negated by the Colne Estuary SPA/ Ramsar being over 5km away. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is 'indirect' by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to the designated bird species.

- Environmental Quality Standards (EQS's)

.EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at

	preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. **Toxic effects - metals** The residual concentrations of metals in the discharge as

	outlined in Table 1 are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS. It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year. Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being ‘insignificant’. In H1 terms ‘insignificant’ means that it could not breach an EQS to have a toxic effect on any aquatic organism and could not cause a breach of any Water Framework Directive (WFD) target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this. We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge could not have any significant adverse effect on any aquatic flora or fauna outside a limited mixing zone around the discharge point. Because the effluent is buoyant there could be no effect at all on any species inhabiting the bed of the estuary. We are therefore confident that if we allowed the discharge there would be no indirect adverse affect on the designated bird species of the European site by a toxic affect on the species that form part of their habitat or are their food source **Temperature** The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents

	cannot have any adverse temperature effects within the European site. Changing to a new outlet would not make a difference. **pH** The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the designated birds of the European site from pH effects and that the change to the new outlets and discharge arrangements would make no difference. **Turbidity** The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300,000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and therefore could not have any significant adverse affects on the designated bird species of the European site. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion. **Siltation** As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries.

	Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into an average volume of 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation and there would be no threat to the habitat of the designated bird species of the European site. **Salinity** None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the designated bird species of the European site. **Physical Damage** If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the European site. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation. For all the reasons given above and the distance to the Colne Estuary SPA/ Ramsar, we believe that allowing the changes to the permit that the applicant has requested for will have no significant adverse affect on the designated species of the European site.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion

In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: iii) **No Likely Significant Effect** - this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Colne Estuary and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of a day of treated radioactive site drainage. The only possible potential for significant 'in combination' affects from the three Magnox effluents on the European site are from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. Except for arsenic all the metals listed in Table 1, are also in discharges (a) and (b). The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension, or removal of, the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed. **The Environment Agency is minded to:**

	Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent and that ensure no significant adverse affect on the designated species Permit Conditions The permit will have a condition limiting the maximum daily volume in 'dry weather conditions' to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*	
EA Officer:	Bill Greenwood	**Date:26/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Colne Estuary SPA/ Ramsar highlighted.

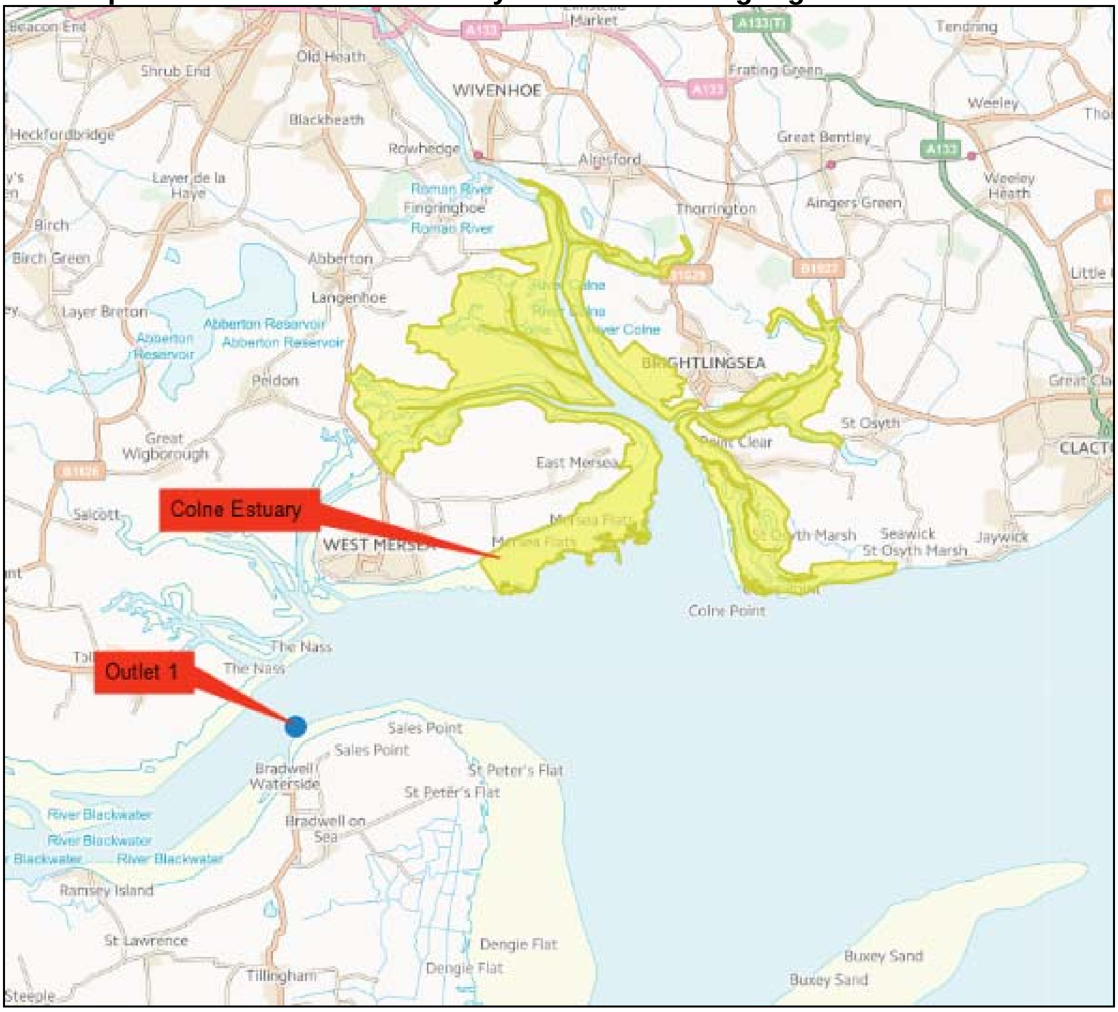

Table 1 - Metals concentrations in mixed effluent discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Derived from Table 3, page 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108.

(14) Colne Estuary (Mid Essex Coast Phase 2) SPA and Ramsar site – Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change

	the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licensed under a different permit, no EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an 'aqueous abatement plant'. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 (located at the end of the document) outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS's. The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become

	blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.
European site names and status:	**Colne Estuary (Mid-Essex Coast Phase 2) Ramsar** **Colne Estuary (Mid Essex Coast Phase 3) SPA (or proposed SPA)**
List of interest features (relevant to this type of permission):	Colne Estuary (Mid Essex Coast Phase 3) SPA 3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Little tern (3.8), Pochard (3.8), Redshank (3.8), Ringed plover (3.8), Seabirds (>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Little tern (3.9), Pochard (3.9), Redshank (3.9), Ringed plover (3.9), Seabirds (>20, 000) (3.9)) Colne Estuary (Mid-Essex Coast Phase 2) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Redshank (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Redshank (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Redshank (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:

3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Little tern (3.8), Pochard (3.8), Redshank (3.8), Ringed plover (3.8), Seabirds (>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
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	Salinity	See detailed assessment below
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	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
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	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?

No

We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion.

Key Principles of the assessment

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to any aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Also the Colne Estuary SPA/ Ramsar is over 5km from the outlet which significantly reduces the potential impact. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the undiluted effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is ‘indirect’ by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to birds.

- Environmental Quality Standards (EQS’s)

EQS’s are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity

	concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an H1 screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. • Modelling in support of the application Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be

	modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending 100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1. **Toxic effects - Metals** The residual concentrations of metals in the discharge (as outlined in Table 1) are the only potential threat to the interest features of the SSSI from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test. This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet. In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more than sufficient to prevent any breach of EQS's outside the mixing zone. We are therefore very confident that the metals in the discharge could have no significant adverse impact on any aquatic organisms outside a limited mixing zone. They could therefore have no affect on the designated bird species by diminishing their habitat or food sources. **Temperature** The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature

	rise will be insignificant. There could therefore be no adverse temperature effects on the designated bird species of the European sites or their habitat from the separation of the effluents and the use of the new outlet structure. **pH** The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the designated bird species of the European site or their habitat outside it. **Turbidity and siltation** Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can therefore have no effect on the designated species of the European site or their habitat. **Salinity** The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary and definitely not on the Colne Estuary SPA/ Ramsar over 5km away. Changing to a new outlet structure will not change this situation. **Physical Damage** The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,000 m3) to have any physical effect on the interest features of the Colne Estuary SPA/ Ramsar. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion

In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: iv) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Colne and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration. The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. The metals listed in Table 1 are also in the FED effluent and discharge (b) also contains traces of chromium, copper, lead, nickel and zinc The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed.

	The Environment Agency is minded to: **Issue the permission with conditions to ensure no significant adverse affect on the designated species of the European site.** Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents. Permit Conditions The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge. The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped. **Your agreement to granting the variation is sought on this basis.**	
EA Officer:	Bill Greenwood	**Date: 26/3/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B Suggested scope of the EA appropriate assessment:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Colne Estuary SPA/ Ramsar highlighted.

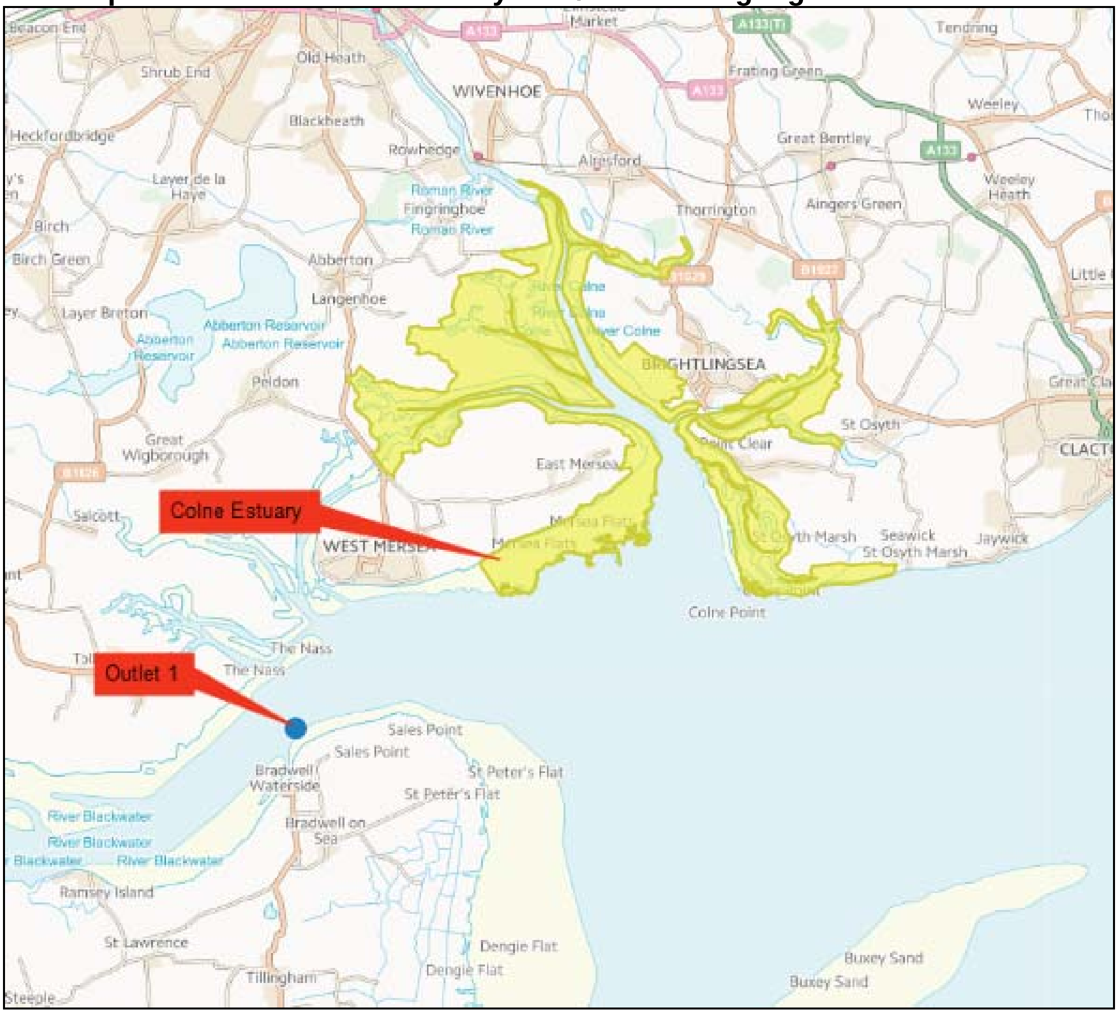


Table 1 - Metals concentrations in the treated radioactive site drainage effluent

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Extracts from Table 3 page 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 page 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108.

(15) Crouch and Roach Estuaries (Mid Essex Coast Phase 3) SPA and Ramsar site – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the

	effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this ‘worst case scenario’ discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as ‘130 m3 in dry weather conditions.’

	With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300.000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is tap water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 (Located at the end of the document) shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

European site names and status:	**Crouch and Roach Estuaries (Mid Essex Coast Phase 3) SPA (or proposed SPA)** **Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar**
List of interest features (relevant to this type of permission):	Crouch and Roach Estuaries (Mid Essex Coast Phase 3) SPA 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Hen Harrier (3.4) 3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9)) Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Brent goose (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	**Potential hazard:**	**Potential exposure to hazard and mechanism of effect/impact if known:**

3.4 Birds of lowland wet grasslands (Brent goose (3.4), Hen Harrier (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below

	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?	**No** **Key Principles of the assessment** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Any potential effect is further negated by the Crouch and Roach Estuaries SPA/ Ramsar being 17km away. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is ‘indirect’ by causing harm to the aquatic flora and fauna that

	provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to the designated bird species. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of

	each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. **Toxic effects - metals** The residual concentrations of metals in the discharge as outlined in Table 1 are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS. It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year. Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being 'insignificant'. In H1 terms 'insignificant' means that it could not breach an EQS to have a toxic effect on any aquatic organism and could not cause a breach of any Water Framework Directive (WFD) target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this. We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge could not have any significant adverse effect on any aquatic flora or fauna

	outside a limited mixing zone around the discharge point. Because the effluent is buoyant there could be no effect at all on any species inhabiting the bed of the estuary. We are therefore confident that if we allowed the discharge there would be no indirect adverse affect on the designated bird species of the European site by a toxic affect on the species that form part of their habitat or are their food source **Temperature** The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the European site. Changing to a new outlet would not make a difference. **pH** The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the designated birds of the European site from pH effects and that the change to the new outlets and discharge arrangements would make no difference. **Turbidity** The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels

	within the receiving Blackwater Estuary or beyond and therefore could not have any significant adverse affects on the designated bird species of the European site. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion. **Siltation** As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into an average volume of 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation and their would be no threat to the habitat of the designated bird species of the European site. **Salinity** None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the designated bird species of the European site.. **Physical Damage** If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the European site. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation. For all the reasons given above and the distance to the

	Crouch and Roach Estuaries SPA/ Ramsar, we believe that allowing the changes to the permit that the applicant has requested for will have no significant adverse affect on the designated species of the European site.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: v) **No Likely Significant Effect** - this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licencing plans, projects and operations in the catchment of the Crouch and Roach Estuaries and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of a day of treated radioactive site drainage. The only possible potential for significant 'in combination' affects from the three Magnox effluents on the European site are from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. Except for arsenic all the metals listed in Table 1, are also in discharges (a) and (b). The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension, or removal of, the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed. **The Environment Agency is minded to:**

	Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent and that ensure no significant adverse affect on the designated species Permit Conditions The permit will have a condition limiting the maximum daily volume in ‘ dry weather conditions’ to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*	
EA Officer:	Bill Greenwood	**Date:26/2/2103**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Crouch & Roach Estuaries SPA/ Ramsar highlighted.

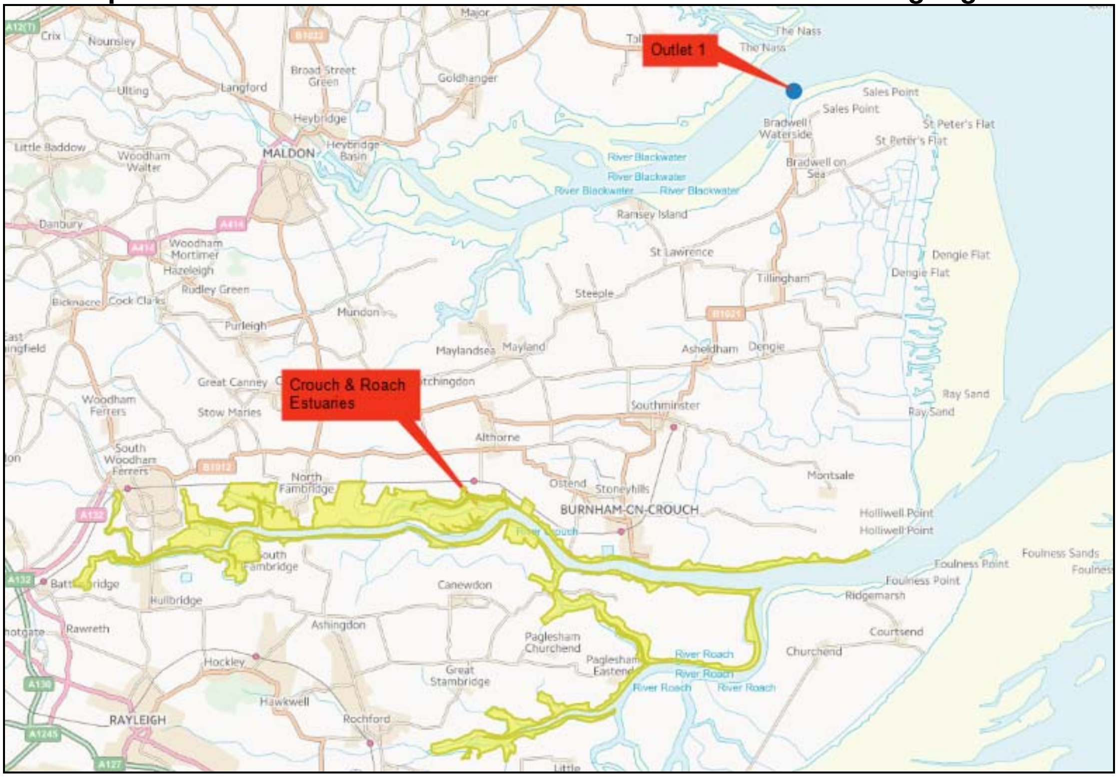


Table 1 - Metals concentrations in mixed effluent discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Derived from Table 3, page 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108.

(16) Crouch and Roach Estuaries (Mid Essex Coast Phase 3) SPA and Ramsar site – Radioactive site drainage.

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change

	the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licensed under a different permit, no EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an 'aqueous abatement plant'. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 (located at the end of the document) outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS's. The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become

	blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.
European site names and status:	**Crouch and Roach Estuaries (Mid Essex Coast Phase 3) SPA (or proposed SPA)** **Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar**
List of interest features (relevant to this type of permission):	Crouch and Roach Estuaries (Mid Essex Coast Phase 3) SPA 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Hen Harrier (3.4) 3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9)) Crouch and Roach Estuaries (Mid-Essex Coast Phase 3) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Brent goose (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	**Potential hazard:**	**Potential exposure to hazard and mechanism of effect/impact if known:**

3.4 Birds of lowland wet grasslands (Brent goose (3.4), Hen Harrier (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below

	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?	
Alone?	**No** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Also the Crouch and Roach Estuary SPA/ Ramsar is 17km from the outlet which significantly reduces the potential impact. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the undiluted effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is 'indirect' by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an

	acceptable mixing zone we can be sure that there would be no threat to birds. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In

	this case the applicant provided an H1 screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. • Modelling in support of the application Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending 100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1. **Toxic effects - Metals** The residual concentrations of metals in the discharge (as outlined in Table 1) are the only potential threat to the interest features of the SSSI from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test. This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet. In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more than sufficient to prevent any breach of EQS's outside the

	mixing zone. We are therefore very confident that the metals in the discharge could have no significant adverse impact on any aquatic organisms outside a limited mixing zone. They could therefore have no affect on the designated bird species by diminishing their habitat or food sources. **Temperature** The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the designated bird species of the European sites or their habitat from the separation of the effluents and the use of the new outlet structure. **pH** The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the designated bird species of the European site or their habitat outside it. **Turbidity and siltation** Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can therefore have no effect on the designated species of the European site or their habitat. **Salinity** The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary. Added to this the Colne Esturay SPA/ Ramsar is over 17km away. Changing to a new outlet structure will not change this situation. **Physical Damage** The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,000 m3) to have any physical effect on the interest features of the Crouch and Roach Estuaries SPA/ Ramsar. Changing to the new outlet will not change that. In fact it may improve matters

	because large volumes of seawater to carry the effluent out will no longer be required.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: vi) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Crouch and Roach Estuaries and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration. The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. The metals listed in Table 1 are also in the FED effluent and discharge (b) also contains traces of chromium, copper, lead, nickel and zinc The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they

	feed. **The Environment Agency is minded to:** **Issue the permission with conditions to ensure no significant adverse affect on the designated species of the European sitel** Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents. Permit Conditions The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge. The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped. **Your agreement to granting the variation is sought on this basis.**	
EA Officer:	Bill Greenwood	**Date: 26/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B Suggested scope of the EA appropriate assessment:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Crouch & Roach Estuaries SPA/ Ramsar highlighted.

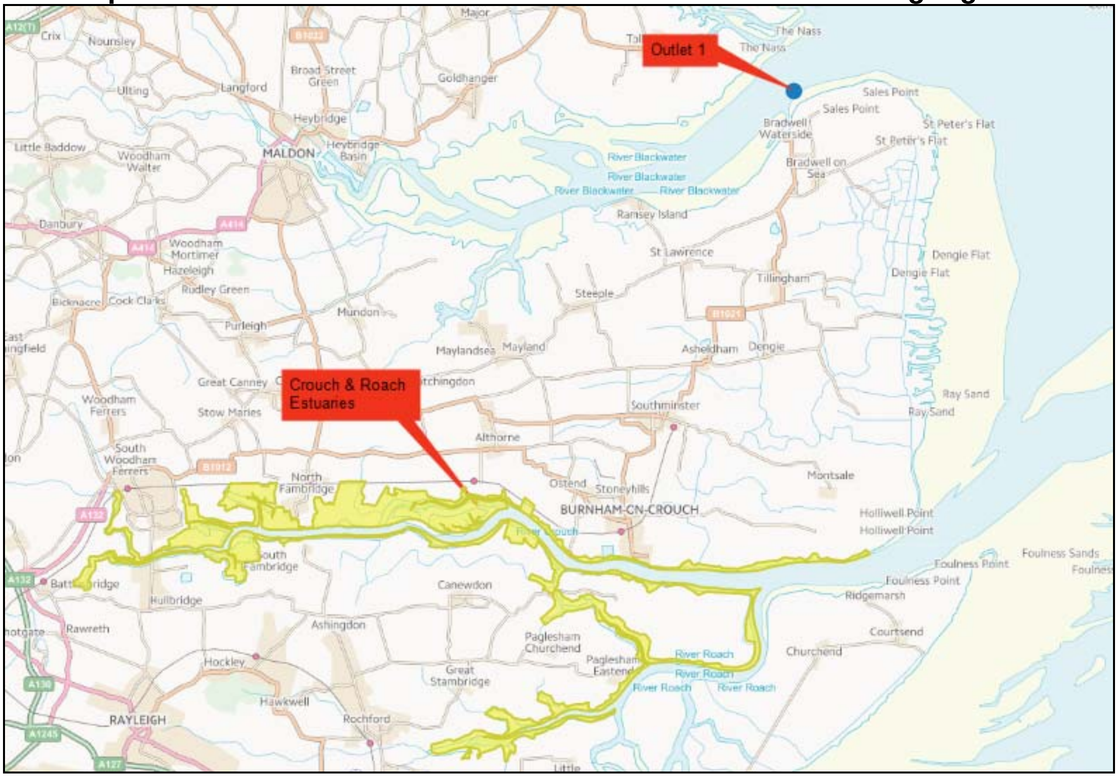


Table 1 - Metals concentrations in the treated radioactive site drainage effluent

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Extracts from Table 3 page 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 page 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108.

(17) The Dengie (Mid Essex Coast Phase 1) SPA and Ramsar site – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the

	effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this ‘worst case scenario’ discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as ‘130 m3 in dry weather conditions.’

	With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300.000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is tap water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 (Located at the end of the document) shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

European site names and status:	**Dengie (Mid-Essex Coast Phase 1) Ramsar** **Dengie (Mid-Essex Coast Phase 3) SPA (or proposed SPA)**
List of interest features (relevant to this type of permission):	Dengie (Mid-Essex Coast Phase 1) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Knot (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Grey plover (3.8), Knot (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Grey plover (3.9), Knot (3.9), Waterfowl(>20, 000) (3.9)) Dengie (Mid-Essex Coast Phase 3) SPA 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4) 3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Knot (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Knot (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	**Potential hazard:**	**Potential exposure to hazard and mechanism of effect/impact if known:**

1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Knot (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Grey plover (3.8), Knot (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Grey plover (3.9), Knot (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below

	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Knot (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Knot (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?

No

Key Principles of the assessment

We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion.

Key Principles of the assessment

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is ‘indirect’ by causing harm to the aquatic flora and fauna that

	provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to the designated bird species. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it

	indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. **Toxic effects - metals** The residual concentrations of metals in the discharge as outlined in Table 1 are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS. It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year. Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being 'insignificant'. In H1 terms 'insignificant' means that it could not breach an EQS to have a toxic effect on any aquatic organism and could not cause a breach of any Water Framework Directive (WFD) target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this. We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge could not have any significant adverse effect on any aquatic flora or fauna outside a limited mixing zone around the discharge point.

	Because the effluent is buoyant there could be no effect at all on any species inhabiting the bed of the estuary. We are therefore confident that if we allowed the discharge there would be no indirect adverse affect on the designated bird species of the European site by a toxic affect on the species that form part of their habitat or are their food source **Temperature** The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the European site. Changing to a new outlet would not make a difference. **pH** The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the designated birds of the European site from pH effects and that the change to the new outlets and discharge arrangements would make no difference. **Turbidity** The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and

	therefore could not have any significant adverse affects on the designated bird species of the European site.. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion. **Siltation** As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into an average volume of 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation and their would be no threat to the habitat of the designated bird species of the European site. **Salinity** None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the designated bird species of the European site.. **Physical Damage** If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the European site. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation. For all the reasons given above we believe that allowing the changes to the permit that the applicant has requested

	for will have no significant adverse affect on the designated species of the European site.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: vii) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licencing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of a day of treated radioactive site drainage. The only possible potential for significant 'in combination' affects from the three Magnox effluents on the European site are from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. Except for arsenic all the metals listed in Table 1, are also in discharges (a) and (b). The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension, or removal of, the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed. **The Environment Agency is minded to:**

	Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent and that ensure no significant adverse affect on the designated species Permit Conditions The permit will have a condition limiting the maximum daily volume in ' dry weather conditions' to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*	
EA Officer:	Bill Greenwood	**Date: 26/3/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Dengie SPA/ Ramsar highlighted.

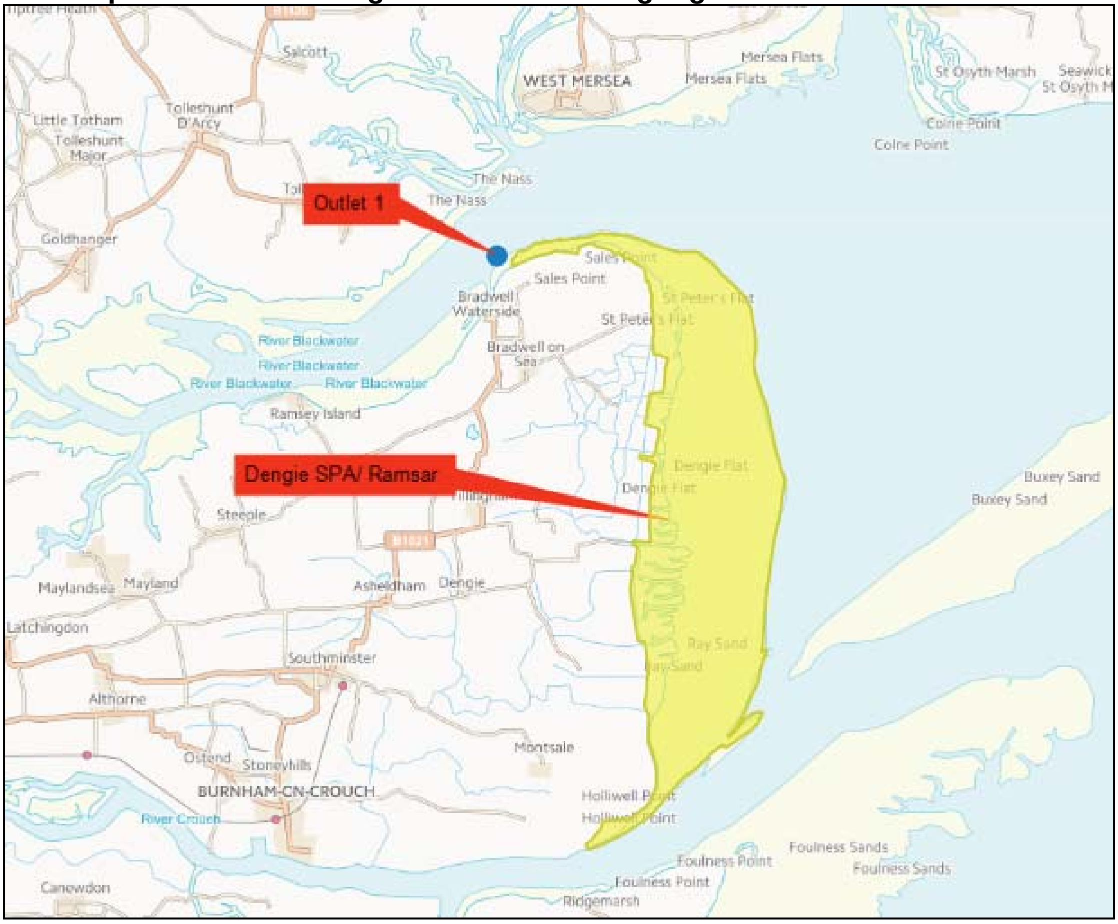


Table 1 - Metals concentrations in mixed effluent discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Derived from Table 3, page 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108.

(18) The Dengie (Mid Essex Coast Phase 1) SPA and Ramsar site – Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change

	the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licensed under a different permit, no EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an 'aqueous abatement plant'. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 (located at the end of the document) outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS's. The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become

	blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.
European site names and status:	**Dengie (Mid-Essex Coast Phase 1) Ramsar** **Dengie (Mid-Essex Coast Phase 3) SPA (or proposed SPA)**
List of interest features (relevant to this type of permission):	Dengie (Mid-Essex Coast Phase 1) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Knot (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Grey plover (3.8), Knot (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Grey plover (3.9), Knot (3.9), Waterfowl(>20, 000) (3.9)) Dengie (Mid-Essex Coast Phase 3) SPA 3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4) 3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Knot (3.8) 3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Knot (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	**Potential hazard:**	**Potential exposure to hazard and mechanism of effect/impact if known:**

1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Knot (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Grey plover (3.8), Knot (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Grey plover (3.9), Knot (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.4 Birds of lowland wet grasslands (Brent goose (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Hen Harrier (3.6), Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below

	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Brent goose (3.8), Hen harrier (3.8), Knot (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Brent goose (3.9), Hen harrier (3.9), Knot (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?

No

We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion.

Key Principles of the assessment

In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the undiluted effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is ‘indirect’ by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable

	mixing zone we can be sure that there would be no threat to birds. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach

	based on European level guidance on mixing zones. In this case the applicant provided an H1 screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. • Modelling in support of the application Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending 100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1. **Toxic effects - Metals** The residual concentrations of metals in the discharge (as outlined in Table 1) are the only potential threat to the interest features of the SSSI from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test. This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet. In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more

	than sufficient to prevent any breach of EQS's outside the mixing zone. We are therefore very confident that the metals in the discharge could have no significant adverse impact on any aquatic organisms outside a limited mixing zone. They could therefore have no affect on the designated bird species by diminishing their habitat or food sources. **Temperature** The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the designated bird species of the European sites or their habitat from the separation of the effluents and the use of the new outlet structure. **pH** The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the designated bird species of the European site or their habitat outside it. **Turbidity and siltation** Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can therefore have no effect on the designated species of the European site or their habitat. **Salinity** The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary and therefore the Dengie SPA/ Ramsar. Changing to a new outlet structure will not change this situation. **Physical Damage** The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,000 m3) to have any physical effect on the interest features of the receiving Blackwater Estuary and therefore the Dengie SPA/ Ramsar. Changing to the new outlet will not change that.

	In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities? .	As a result of this risk assessment, the Environment Agency can conclude that: viii) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration. The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. The metals listed in Table 1 are also in the FED effluent and discharge (b) also contains traces of chromium, copper, lead, nickel and zinc The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed.

<table>
<tr><td></td><td colspan="2">The Environment Agency is minded to:

Issue the permission with conditions to ensure no significant adverse affect on the designated species of the European site.

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis.</td></tr>
<tr><td>EA Officer:</td><td>Bill Greenwood</td><td>Date: 26/2/2016</td></tr>
<tr><td>Natural England/CCW comment on assessment:</td><td colspan="2">.</td></tr>
<tr><td>Natural England/CCW Officer:</td><td></td><td>Date:</td></tr>
<tr><td colspan="3">If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).</td></tr>
</table>

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Dengie SPA/ Ramsar highlighted.

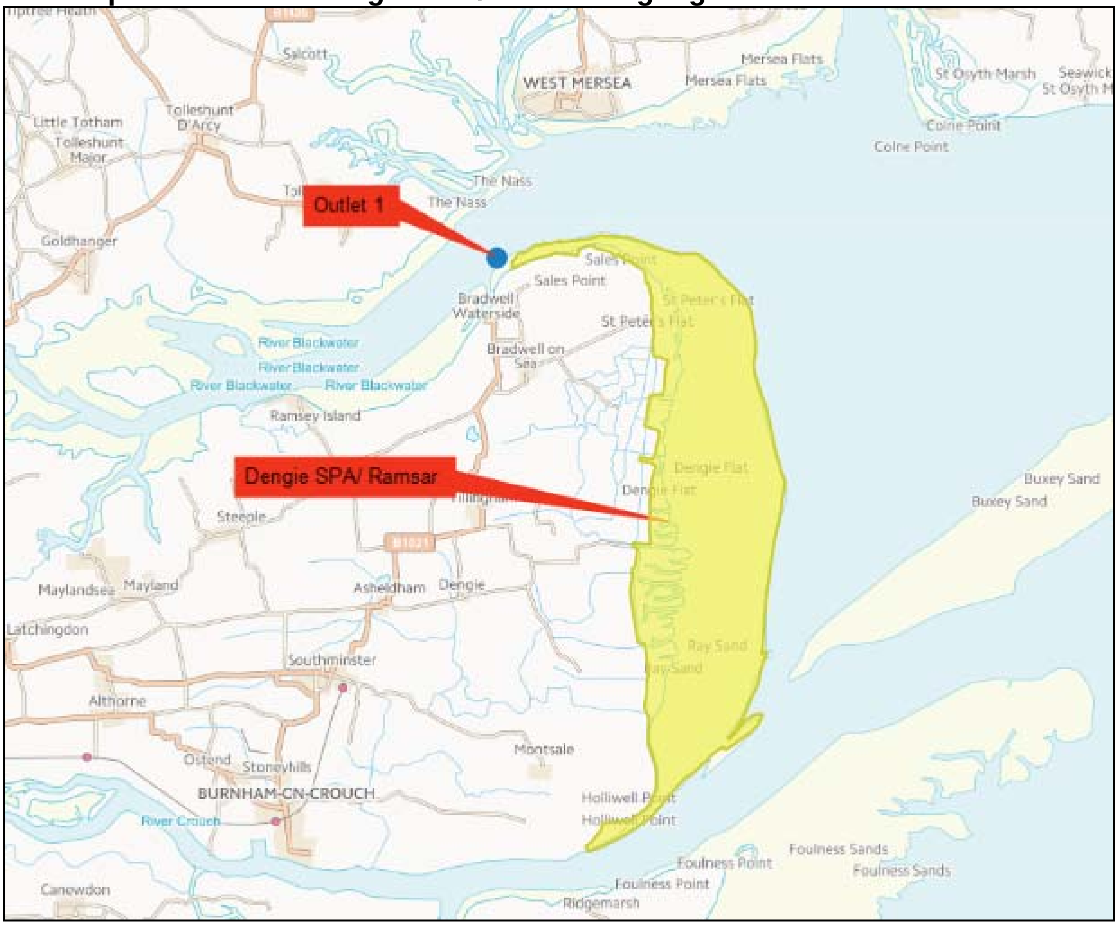


Table 1 - Metals concentrations in the treated radioactive site drainage effluent

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Extracts from Table 3 page 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 page 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108.

(19) Foulness (Mid Essex Coast Phase 5) SPA and Ramsar site – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the

	effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this ‘worst case scenario’ discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as ‘130 m3 in dry weather conditions.’

	With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300.000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is tap water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 (Located at the end of the document) shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

European site names and status:	**Foulness (Mid-Essex Coast Phase 5) SPA (or proposed SPA)** **Foulness (Mid-Essex Coast Phase 5) Ramsar**
List of interest features (relevant to this type of permission):	Foulness (Mid-Essex Coast Phase 5) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Grey plover (3.4), Knot (3.4), Oystercatcher (3.4), Redshank (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Bar-tailed Godwit (3.8), Brent goose (3.8), Grey plover (3.8), Knot (3.8), Oystercatcher (3.8), Redshank (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Bar-tailed Godwit (3.9), Brent goose (3.9), Grey plover (3.9), Knot (3.9), Oystercatcher (3.9), Redshank (3.9), Waterfowl(>20, 000) (3.9)) Foulness (Mid-Essex Coast Phase 5) SPA 3.1 Birds of uplands (Common Redshank (3.1), Hen harrier (3.1) 3.10 Birds of open sea and offshore rocks (Common Tern (3.10), Little tern (3.10), Sandwich tern (3.10) 3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Common Redshank (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4), Oystercatcher (3.4) 3.6 Birds of lowland freshwaters and their margins (Avocet (3.6), Common Redshank (3.6), Common Tern (3.6), Hen Harrier (3.6), Ringed plover (3.6), Waterfowl(>20, 000) (3.6)). 3.8 Birds of coastal habitats (Avocet (3.8), Bar-tailed Godwit (3.8), Brent goose (3.8), Common Redshank (3.8), Common Tern (3.8), Grey plover (3.8), Hen harrier (3.8), Knot (3.8), Little tern (3.8), Oystercatcher (3.8), Ringed plover (3.8), Sandwich tern (3.8), Waterfowl(>20, 000) (3.8)) 3.9 Birds of estuarine habitats (Avocet (3.9), Bar-tailed Godwit (3.9), Brent goose (3.9), Common Redshank (3.9), Common Tern (3.9), Grey plover (3.9), Hen harrier (3.9), Knot (3.9), Little tern (3.9), Oystercatcher (3.9), Ringed plover (3.9), Sandwich tern (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:

1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Grey plover (3.4), Knot (3.4), Oystercatcher (3.4), Redshank (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Bar-tailed Godwit (3.8), Brent goose (3.8), Grey plover (3.8), Knot (3.8), Oystercatcher (3.8), Redshank (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Bar-tailed Godwit (3.9), Brent goose (3.9), Grey plover (3.9), Knot (3.9), Oystercatcher (3.9), Redshank (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.1 Birds of uplands (Common Redshank (3.1), Hen harrier (3.1))	Toxic contamination	See detailed assessment below
3.10 Birds of open sea and offshore rocks (Common Tern (3.10), Little tern (3.10), Sandwich tern (3.10))	Toxic contamination	See detailed assessment below

3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Common Redshank (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4), Oystercatcher (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Avocet (3.6), Common Redshank (3.6), Common Tern (3.6), Hen Harrier (3.6), Ringed plover (3.6), Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Avocet (3.8), Bar-tailed Godwit (3.8), Brent goose (3.8), Common Redshank (3.8), Common Tern (3.8), Grey plover (3.8), Hen harrier (3.8), Knot (3.8), Little tern (3.8), Oystercatcher (3.8), Ringed plover (3.8), Sandwich tern (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Avocet (3.9), Bar-tailed Godwit (3.9), Brent goose (3.9), Common Redshank (3.9), Common Tern (3.9), Grey plover (3.9), Hen harrier (3.9), Knot (3.9), Little tern (3.9), Oystercatcher (3.9), Ringed plover (3.9), Sandwich tern (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?	
Alone?	**No** **Key Principles of the assessment** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge

	(as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Any potential effect is further negated by the Foulness SPA/ Ramsar being over 16km away. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is 'indirect' by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to the designated bird species. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be

	minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. **Toxic effects - metals** The residual concentrations of metals in the discharge as outlined in Table 1 are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS. It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year. Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being 'insignificant'. In H1 terms 'insignificant' means that it

	could not breach an EQS to have a toxic effect on any aquatic organism and could not cause a breach of any Water Framework Directive (WFD) target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this. We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that any of the metals in the discharge could not have any significant adverse effect on any aquatic flora or fauna outside a limited mixing zone around the discharge point. Because the effluent is buoyant there could be no effect at all on any species inhabiting the bed of the estuary. We are therefore confident that if we allowed the discharge there would be no indirect adverse affect on the designated bird species of the European site by a toxic affect on the species that form part of their habitat or are their food source **Temperature** The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the European site. Changing to a new outlet would not make a difference. **pH** The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the designated birds of the European site from pH effects and that the change to the new outlets and discharge arrangements would make no difference. **Turbidity** The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a

	concentration at which most particles are invisible to the eye. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and therefore could not have any significant adverse affects on the designated bird species of the European site.. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion. **Siltation** As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into an average volume of 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation and their would be no threat to the habitat of the designated bird species of the European site. **Salinity** None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the designated bird species of the European site.. **Physical Damage** If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get

	good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the European site. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation. For all the reasons given above and the distance to the Foulness SPA/ Ramsar we believe that allowing the changes to the permit that the applicant has requested for will have no significant adverse affect on the designated species of the European site.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities? .	As a result of this risk assessment, the Environment Agency can conclude that: ix) **No Likely Significant Effect** - this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Foulness SPA/ Ramsar and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of a day of treated radioactive site drainage. The only possible potential for significant 'in combination' affects from the three Magnox effluents on the European site are from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. Except for arsenic all the metals listed in Table 1, are also in discharges (a) and (b). The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension, or removal of, the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed. **The Environment Agency is minded to:**

	Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent and that ensure no significant adverse affect on the designated species Permit Conditions The permit will have a condition limiting the maximum daily volume in ‘ dry weather conditions’ to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*	
EA Officer:	Bill Greenwood	**Date: 26/3/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Foulness SPA/ Ramsar highlighted.

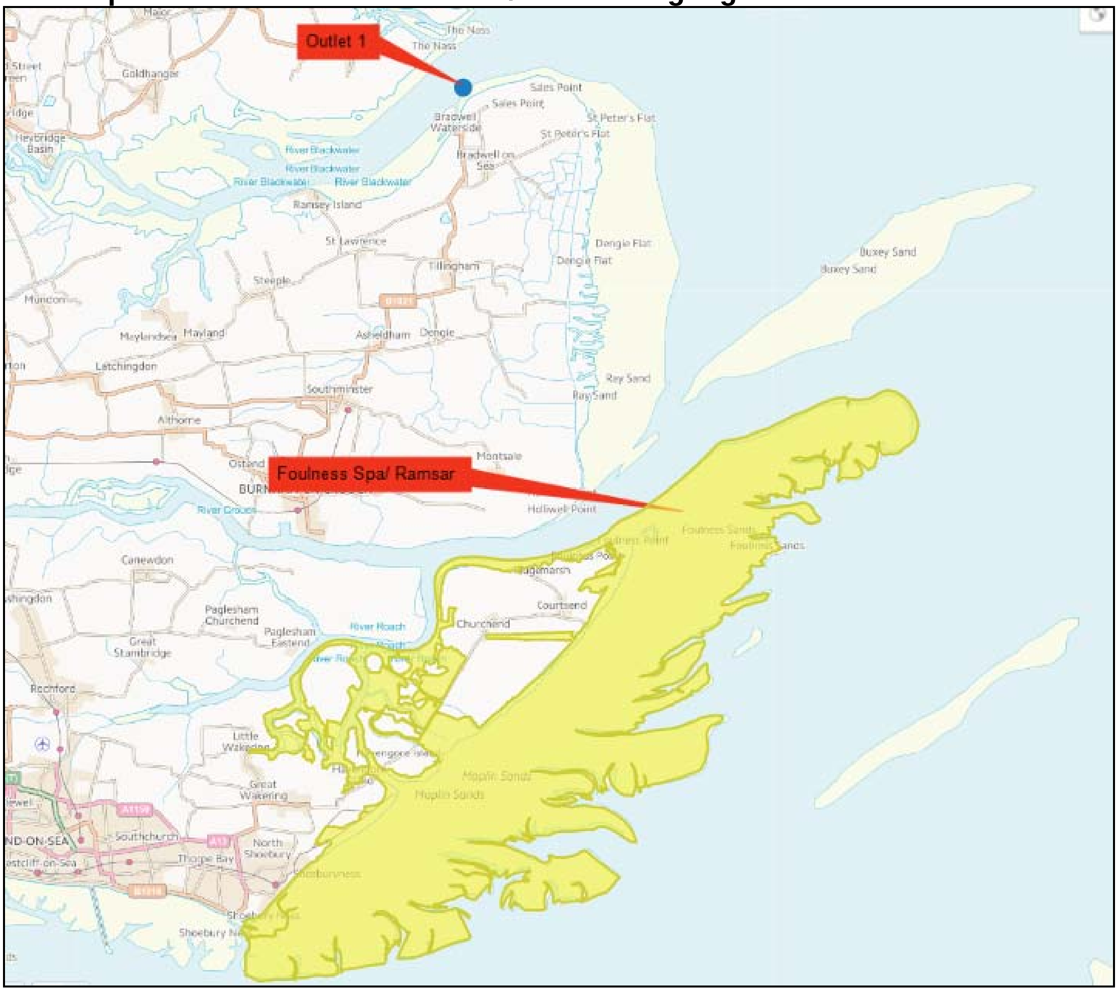


Table 1 - Metals concentrations in mixed effluent discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Derived from Table 3, page 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108.

(20) Foulness (Mid Essex Coast Phase 5) SPA and Ramsar site – Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using

	large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licensed under a different permit, no EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an ‘aqueous abatement plant’. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes. to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 (located at the end of the document) outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS’s. The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the

	purpose. In future because the old pipe may become blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.
European site names and status:	**Foulness (Mid-Essex Coast Phase 5) SPA (or proposed SPA)** **Foulness (Mid-Essex Coast Phase 5) Ramsar**
List of interest features (relevant to this type of permission):	Foulness (Mid-Essex Coast Phase 5) Ramsar 1.10 Coastal Habitats (Wetland Plants and Invertebrates) 3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Grey plover (3.4), Knot (3.4), Oystercatcher (3.4), Redshank (3.4) 3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6) 3.8 Birds of coastal habitats (Bar-tailed Godwit (3.8), Brent goose (3.8), Grey plover (3.8), Knot (3.8), Oystercatcher (3.8), Redshank (3.8), Waterfowl(>20, 000) (3.8) 3.9 Birds of estuarine habitats (Bar-tailed Godwit (3.9), Brent goose (3.9), Grey plover (3.9), Knot (3.9), Oystercatcher (3.9), Redshank (3.9), Waterfowl(>20, 000) (3.9)) Foulness (Mid-Essex Coast Phase 5) SPA 3.1 Birds of uplands (Common Redshank (3.1), Hen harrier (3.1) 3.10 Birds of open sea and offshore rocks (Common Tern (3.10), Little tern (3.10), Sandwich tern (3.10) 3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Common Redshank (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4), Oystercatcher (3.4) 3.6 Birds of lowland freshwaters and their margins (Avocet (3.6), Common Redshank (3.6), Common Tern (3.6), Hen Harrier (3.6), Ringed plover (3.6), Waterfowl(>20, 000) (3.6)). 3.8 Birds of coastal habitats (Avocet (3.8), Bar-tailed Godwit (3.8), Brent goose (3.8), Common Redshank (3.8), Common Tern (3.8), Grey plover (3.8), Hen harrier (3.8), Knot (3.8), Little tern (3.8), Oystercatcher (3.8), Ringed plover (3.8), Sandwich tern (3.8), Waterfowl(>20, 000) (3.8)) 3.9 Birds of estuarine habitats (Avocet (3.9), Bar-tailed Godwit (3.9), Brent goose (3.9), Common Redshank (3.9), Common Tern (3.9), Grey plover (3.9), Hen harrier (3.9), Knot (3.9), Little tern (3.9), Oystercatcher (3.9), Ringed plover (3.9), Sandwich tern (3.9), Waterfowl(>20, 000) (3.9))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:

1.10 Coastal Habitats (Wetland Plants and Invertebrates)	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	pH	See detailed assessment below
3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Grey plover (3.4), Knot (3.4), Oystercatcher (3.4), Redshank (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Bar-tailed Godwit (3.8), Brent goose (3.8), Grey plover (3.8), Knot (3.8), Oystercatcher (3.8), Redshank (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Bar-tailed Godwit (3.9), Brent goose (3.9), Grey plover (3.9), Knot (3.9), Oystercatcher (3.9), Redshank (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.1 Birds of uplands (Common Redshank (3.1), Hen harrier (3.1))	Toxic contamination	See detailed assessment below
3.10 Birds of open sea and offshore rocks (Common Tern (3.10), Little tern (3.10), Sandwich tern (3.10))	Toxic contamination	See detailed assessment below

3.4 Birds of lowland wet grasslands (Bar-tailed godwit (3.4), Brent goose (3.4), Common Redshank (3.4), Grey plover (3.4), Hen Harrier (3.4), Knot (3.4), Oystercatcher (3.4))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Avocet (3.6), Common Redshank (3.6), Common Tern (3.6), Hen Harrier (3.6), Ringed plover (3.6), Waterfowl(>20, 000) (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below
3.8 Birds of coastal habitats (Avocet (3.8), Bar-tailed Godwit (3.8), Brent goose (3.8), Common Redshank (3.8), Common Tern (3.8), Grey plover (3.8), Hen harrier (3.8), Knot (3.8), Little tern (3.8), Oystercatcher (3.8), Ringed plover (3.8), Sandwich tern (3.8), Waterfowl(>20, 000) (3.8))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
3.9 Birds of estuarine habitats (Avocet (3.9), Bar-tailed Godwit (3.9), Brent goose (3.9), Common Redshank (3.9), Common Tern (3.9), Grey plover (3.9), Hen harrier (3.9), Knot (3.9), Little tern (3.9), Oystercatcher (3.9), Ringed plover (3.9), Sandwich tern (3.9), Waterfowl(>20, 000) (3.9))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Physical Damage	See detailed assessment below
	Salinity	See detailed assessment below
	Siltation	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?	
Alone?	**No** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to any aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed

	within a short distance it is unlikely that any of the designated birds would have direct contact with it. Also Foulness SPA/ Ramsar is over 16km from the outlet which significantly reduces the potential impact. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the undiluted effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is 'indirect' by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to birds. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface*

	water discharges', incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an H1 screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. • Modelling in support of the application Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending 100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1. **Toxic effects - Metals** The residual concentrations of metals in the discharge (as outlined in Table 1) are the only potential threat to the interest features of the SSSI from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test. This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the

	waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet. In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more than sufficient to prevent any breach of EQS's outside the mixing zone. We are therefore very confident that the metals in the discharge could have no significant adverse impact on any aquatic organisms outside a limited mixing zone. They could therefore have no affect on the designated bird species by diminishing their habitat or food sources. **Temperature** The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the designated bird species of the European sites or their habitat from the separation of the effluents and the use of the new outlet structure. **pH** The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the designated bird species of the European site or their habitat outside it. **Turbidity and siltation** Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can therefore have no effect on the designated species of the European site or their habitat. **Salinity**

	The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary. Added to this the Foulness SPA/ Ramsar is over 16km away. Changing to a new outlet structure will not change this situation. **Physical Damage** The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,000 m3) to have any physical effect on the interest features of the Foulness SPA/ Ramsar. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities? for consulting about new PPP.	As a result of this risk assessment, the Environment Agency can conclude that: x) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Foulness SPA/ Ramsar and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration. The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. The metals listed in Table 1 are also in the FED effluent and discharge (b) also contains traces of chromium, copper, lead, nickel and zinc The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed.

	The Environment Agency is minded to: **Issue the permission with conditions to ensure no significant adverse affect on the designated species of the European site.** Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents. Permit Conditions The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge. The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped. **Your agreement to granting the variation is sought on this basis.**	
EA Officer:	Bill Greenwood	**Date: 26/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B Suggested scope of the EA appropriate assessment:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Foulness SPA/ Ramsar highlighted.

Table 1 - Metals concentrations in the treated radioactive site drainage effluent

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Extracts from Table 3 page 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 page 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108.

(21) Outer Thames Estuary SPA – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of various heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit and not addressed here. In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Using this will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using

	the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the mixed effluents The treated radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this ‘worst case scenario’ discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as ‘130 m3 in dry weather conditions.’

	With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300.000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for this effluent on any new permit if we granted one. The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no hazardous pollutants as can be readily understood since its source is tap water. **Treatment and discharge quality** The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 (Located at the end of the document) shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.
European site name and status:	**Outer Thames Estuary SPA (or proposed SPA)**

List of interest features (relevant to this type of permission):	Outer Thames Estuary SPA 3.10 Birds of open sea and offshore rocks (Red-throated diver (3.10) 3.6 Birds of lowland freshwaters and their margins (Red-throated diver (3.6))
Is this application necessary to manage the site for nature conservation?	No

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:
3.10 Birds of open sea and offshore rocks (Red-throated diver (3.10))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Red-throated diver (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?	**No** **Key Principles of the assessment** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Any potential effect is further negated by the Outer Thames Estuary SPA being over 4.5km away. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is ‘indirect’

	by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to the designated bird species. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or

	threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. **Toxic effects - metals** The residual concentrations of metals in the discharge as outlined in Table 1 are the only real potential threat to the interest features of the SSSI from toxic effects. It can be seen from figures in this table that in the mixed effluent discharge from the Bradwell site the only substance that is above EQS concentrations is chromium. When a discharge is made in dry weather the average concentration of chromium within it would be 6.5 times greater than the appropriate annual average EQS figure. However the maximum concentration of chromium in the effluent would not breach the MAC EQS figure. This means that the effluent could not be toxic to any aquatic flora or fauna even before it gets any dilution within the estuary and it only needs to be diluted 6.5 times as it mixes with estuary waters to avoid breaching the long term AA EQS. It should be noted that in practice discharges at the concentrations above will be intermittent and not occur every day. They will only occur on relatively dry days. On wet days the mixed effluents will be diluted with greater volumes of the uncontaminated runoff from the clear areas of the site. This means that in practice the AA EQS is unlikely to be breached within the estuary even without further dilution. The discharges at higher than AA EQS will be mitigated by others below EQS over the days of a year. Notwithstanding these factors chromium still failed the initial screening so the second stage H1 screening tool was applied. This uses a formula with inputs including discharge rates and concentrations, the appropriate EQS and the existing background concentration of the substance in the water body. Using this formula the chromium in this discharge screened out as being 'insignificant'. In H1 terms 'insignificant' means that it could not breach an EQS to have a toxic effect on any aquatic organism and could not cause a breach of any Water Framework Directive (WFD) target or class boundary. Because the discharge rate for the new outlet structure was used it is valid for the change to the new outlet if we allowed this. We have verified that the results of the H1 screening exercise are valid and on this basis we do not believe that

	any of the metals in the discharge could not have any significant adverse effect on any aquatic flora or fauna outside a limited mixing zone around the discharge point. Because the effluent is buoyant there could be no effect at all on any species inhabiting the bed of the estuary. We are therefore confident that if we allowed the discharge there would be no indirect adverse affect on the designated bird species of the European site by a toxic affect on the species that form part of their habitat or are their food source **Temperature** The mixed effluents will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. Accordingly the mixed effluents cannot have any adverse temperature effects within the European site. Changing to a new outlet would not make a difference. **pH** The only effluent that has the potential to be non-neutral pH in the combined discharges is the treated non radioactive site drainage. However the treatment plant incorporates pH adjustment by controlled infusions of carbon dioxide gas into the influent. This ensures that the alkaline pH of up to 12 is reduced to neutral and using a gas system removes the risk of overdosing and creating an acidic effluent. Mixing with clean rainwater, sewage effluent and treated tap water in the retention chamber before discharge provide further buffering. We are therefore confident that the mixed effluent discharge could have no significant adverse effects on the designated birds of the European site from pH effects and that the change to the new outlets and discharge arrangements would make no difference. **Turbidity** The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant for non–reactive site drainage can achieve around 50 mg/l. There will be no suspended solids in the waste waters from RO treatment and clean site drainage will have very low solids concentrations. All four effluents will have some retention time for solids to settle out in the final chamber before settlement. To put things in perspective it should be remembered that milligrams per litre are parts per million and that 50 mg/l is a concentration at which most particles are invisible to the eye. The Agency’s Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. The dilution available for the mixed effluent discharge (totalling 130 m3 in dry weather) in the estuary (average water volume 106,300.000 m3) is also huge. For these reasons we

	believe that the turbidity of this discharge could have no significant effect on existing background turbidity levels within the receiving Blackwater Estuary or beyond and therefore could not have any significant adverse affects on the designated bird species of the European site. The change to the new outlet structure and discharge arrangements would not make any difference to this conclusion. **Siltation** As stated above the suspended solids concentrations in the combined effluents are within the average range for the receiving estuaries but the daily volumes are vastly lower. This means that the contribution of suspended solids the discharge could make after the change to the new outlets could not possibly make a significant difference to the existing siltation regime in the estuaries. Very roughly speaking the situation would be 10 to 50 mg/l of solids within 130 m3 of effluent put into an average volume of 106,300,000 m3 of estuary with 10 to 100 mg/l of solids. The fact that the discharge would have very similar suspended solids concentrations to the receiving waters also means that it would not pose any risk to interest features close to the discharge point either. Any shellfish or invertebrates (or their habitats) on the estuary bed close to the discharge could not be affected by relatively small additional volumes of water with similar suspended solids concentrations. In other words the prevailing background conditions would not change with regards to siltation and there would be no threat to the habitat of the designated bird species of the European site. **Salinity** None of the effluents in the mixed discharge are saline and the available dilution in the Blackwater Estuary alone for the total daily volume of 130 m3 (in dry weather) means that it is not big enough to have any significant affect on the existing salinity regime. In effect the mixed discharges are just a very small part of the freshwater runoff to the estuary. Changing the outlet structure and discharge arrangements will not make a difference and can have no affect on the designated bird species of the European site. **Physical Damage** If we grant a permit the mixed effluents will be discharged by automatic pumping to three small pipes set near the estuary bed 400 metres from the shore into the main current of the Blackwater estuary. The new outlet structure has been designed to dissipate the flow and get good mixing with the natural currents at a point in the channel that is at least 5 metres below water on all tides. For this reason the discharge will not cause any damage to the estuary bed and there would be no change to the physical habitats within the European site. The absolute maximum of discharge permitted would be reduced from 500,000 m3 a day to 55,000 m3 a day so the potential for physical damage would be reduced from the current situation.

	For all the reasons given above and the distance to the Outer Thames Estuary SPA, we believe that allowing the changes to the permit that the applicant has requested for will have no significant adverse affect on the designated species of the European site.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: xi) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licencing plans, projects and operations in the catchment of the Outer Thames Estuary and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of a day of treated radioactive site drainage. The only possible potential for significant 'in combination' affects from the three Magnox effluents on the European site are from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. Except for arsenic all the metals listed in Table 1, are also in discharges (a) and (b). The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension, or removal of, the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they feed. **The Environment Agency is minded to:**

	Issue the variation permission with new conditions that reflect the new circumstances of using the new outlet and the separation of the radioactive site drainage effluent and that ensure no significant adverse affect on the designated species Permit Conditions The permit will have a condition limiting the maximum daily volume in 'dry weather conditions' to 130 m3 a day and an overall maximum of 50,000 m3 a day. The maximum rate of discharge will also be limited to 303 l/s. It will also incorporate the specification of the discharge structure to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for condition for site drainage discharges. The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report them to us to verify that the metals concentrations in the discharge continue to match those in the application. The exact frequency of self monitoring has not yet been decided but it will be proportionate to the risks. There will also be a requirement to record the date of discharges and the volumes pumped. (*Note The existing permit has a chlorine limit which is no longer necessary because there is no longer any cooling water discharge from the site and no other sources of chlorine.)*	
EA Officer:	Bill Greenwood	**Date: 26/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B Suggested scope of the EA appropriate assessment:
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.
Natural England/CCW comment on scope of EA appropriate assessment:

Natural England/CCW Officer:		**Date:**

Site map – Outlet and Outer Thames Estuary SPA highlighted.

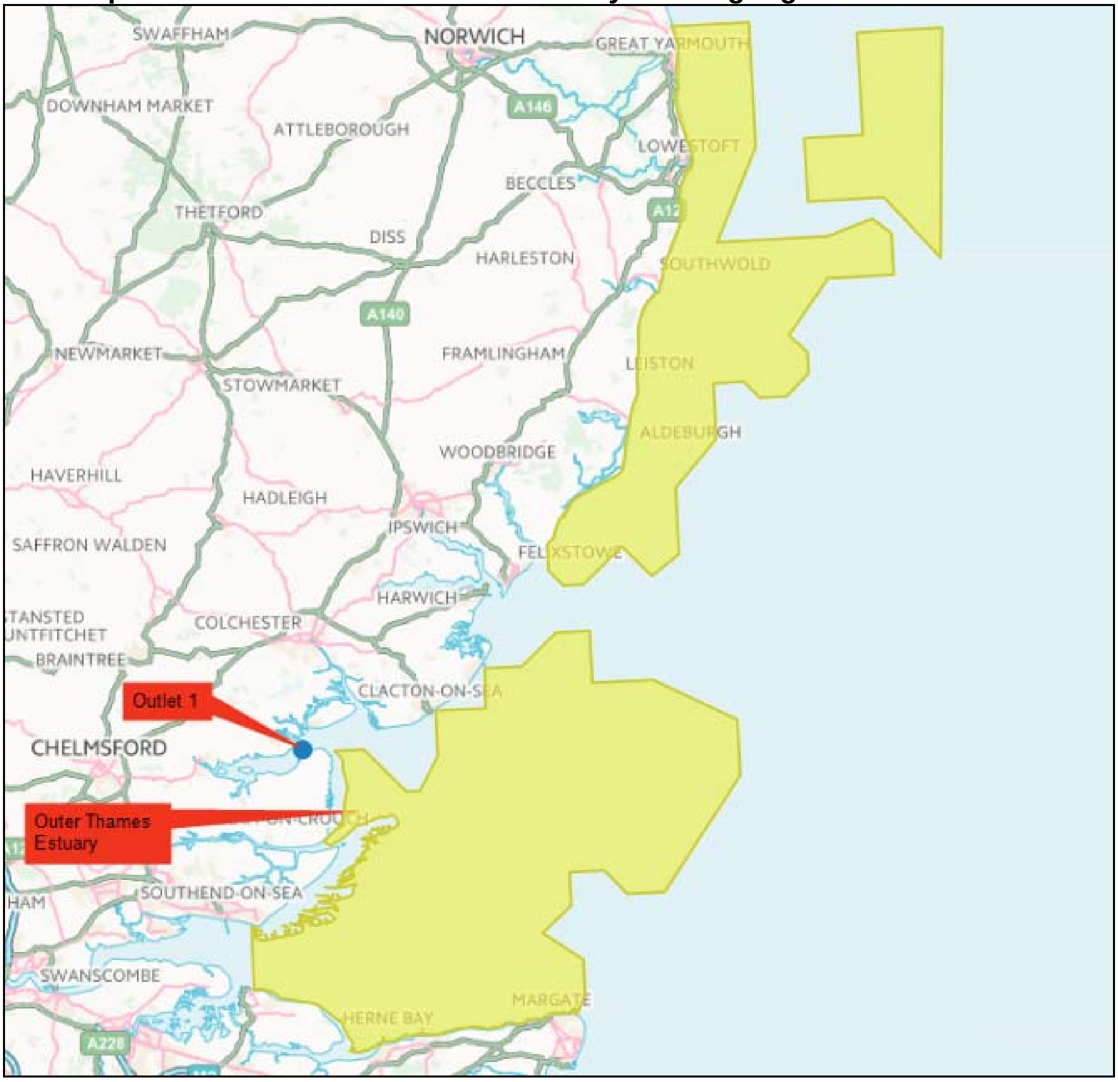


Table 1 - Metals concentrations in mixed effluent discharge compared to EQS's

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	3.88	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Derived from Table 3, page 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108.

(22) Outer Thames Estuary SPA – Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Environmental Permit (Discharge consent)
Environment Agency reference no:	EPR/DP3127XB/V002
National grid reference:	TL 99650 09150
Site description:	Trade Effluent Discharge from Bradwell Site, Magnox Ltd, Bradwell-on-Sea, Southminster, Essex CM0 7HP
Brief description of proposal:	Magnox Ltd, the applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing. The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radionuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here. In recent years the existing large outlet pipe has been

	silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also. The requested changes to the permit are therefore:- • to use the new outlet structure • to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow. • to have two discharges instead of one completely mixed effluent. The two discharges will be:- • A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage • Treated radioactive site drainage This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licensed under a different permit, no EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity. **Volume, rate, contents and discharge arrangement** The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an 'aqueous abatement plant'. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to reduce the pollutants to a level fit for discharge. Table 1 (located at the end of the document) outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS's. The maximum daily volume of the discharge is limited by

	the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.
European site name and status:	**Outer Thames Estuary SPA (or proposed SPA)**
List of interest features (relevant to this type of permission):	Outer Thames Estuary SPA 3.10 Birds of open sea and offshore rocks (Red-throated diver (3.10) 3.6 Birds of lowland freshwaters and their margins (Red-throated diver (3.6))
Is this application necessary to manage the site for nature conservation?	Yes or No? This will be stated within the application if it is.

What potential hazards are likely to affect the interest features (relevant to this type of permission?

Sensitive interest feature:	Potential hazard:	Potential exposure to hazard and mechanism of effect/impact if known:
3.10 Birds of open sea and offshore rocks (Red-throated diver (3.10))	Toxic contamination	See detailed assessment below
3.6 Birds of lowland freshwaters and their margins (Red-throated diver (3.6))	Changes in thermal regime	See detailed assessment below
	Nutrient Enrichment	See detailed assessment below
	Salinity	See detailed assessment below
	Toxic contamination	See detailed assessment below
	Turbidity	See detailed assessment below
	pH	See detailed assessment below

Is the potential scale or magnitude of any effect likely to be significant?

Alone?	**No** We do not believe that the proposed discharge will have any significant adverse affect on the designated bird species of the European site. The principles of our assessment are outlined below and then each potentially

	polluting component of the discharge is addressed in turn to explain how we have reached our conclusion. **Key Principles of the assessment** In assessing the potential impact of the discharge we have sought to be certain that if we allow the discharge (as applied for) it will not pose a risk to <u>any</u> aquatic flora or fauna in the European Site. Because the discharge is of such a small volume in relation to the size of the Blackwater Estuary and the effluent will be fully mixed within a short distance it is unlikely that any of the designated birds would have direct contact with it. Also the Outer Thams Estuary SPA is over 4km from the outlet which significantly reduces the potential impact. Even if they did there would be no direct toxic affect because the concentrations of heavy metals in the undiluted effluent are too low to be harmful to bird species. The only potential for a harmful affect on the designated bird species is 'indirect' by causing harm to the aquatic flora and fauna that provide food for them, or are part of the food chain, or part of the wider ecosystem. If we can be certain that the polluting components of the effluent can not harm any aquatic organisms outside an acceptable mixing zone we can be sure that there would be no threat to birds. • Environmental Quality Standards (EQS's) EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to 1000 or more) to the lowest known toxicity concentration of each substance to any organism to be sure that marginal breaches do not cause any harm. Not all hazardous substances have both types of EQS.. We are therefore confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be cause to any aquatic organisms or their habitat or the wildfowl that depend on them. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010. • Acceptable Mixing Zones and the H1 screening tool Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels

	where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised. The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an H1 screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. • Modelling in support of the application Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending 100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1. **Toxic effects - Metals** The residual concentrations of metals in the discharge (as outlined in Table 1) are the only potential threat to the interest features of the SSSI from toxic effects by the

effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.

This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.

In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more than sufficient to prevent any breach of EQS's outside the mixing zone.

We are therefore very confident that the metals in the discharge could have no significant adverse impact on any aquatic organisms outside a limited mixing zone. They could therefore have no affect on the designated bird species by diminishing their habitat or food sources.

Temperature

The site drainage will be at ambient temperature before being pumped to the outlet. The act of pumping will slightly raise the temperature, however this temperature rise will be insignificant. There could therefore be no adverse temperature effects on the designated bird species of the European sites or their habitat from the separation of the effluents and the use of the new outlet structure.

pH

The first treatment process for the influent is pH adjustment and the effluent will be discharged between the standard pH range of 6-9 that the Agency imposes on most permits. There is no WFD target for pH in marine waters. The only pH target in marine waters is 7 to 9 under the EC directive for the protection of shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7 and the discharge could have absolutely no effect on the designated bird species of the European site or their

	habitat outside it. **Turbidity and siltation** Because the treatment processes involve both filtration and absorption the discharge is virtually free of suspended solids and can therefore have no effect on the designated species of the European site or their habitat. **Salinity** The discharge is non-saline and is far too small to have any influence on the existing background salinity regime even within the receiving Blackwater Estuary and therefore the Outer Thames Esturay SPA which is over 5km away from the discharge point. Changing to a new outlet structure will not change this situation. **Physical Damage** The discharge is far too small (30 m3) in relation to flows in the estuary (average volume 106,300,000 m3) to have any physical effect on the interest features of Outer Thames Estuary. Changing to the new outlet will not change that. In fact it may improve matters because large volumes of seawater to carry the effluent out will no longer be required.
In combination with other Environment Agency permissions, plans or projects?	No – As discussed in conclusion
In combination with permissions, plans or projects with competent authorities?	As a result of this risk assessment, the Environment Agency can conclude that: xii) **No Likely Significant Effect -** this application could act in combination with permissions and/or plans/projects of other competent authorities, consultation has been undertaken and our conclusion is as follows Please see conclusion for a detailed explanation.

Conclusion: **Is there likely to be a significant effect 'alone and/or in combination' on a European site?**	**No** On the 21st of October we wrote to all the other authorities responsible for assessing and licencing plans, projects and operations in the catchment of the Outer Thames SPA/ Ramsar and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries. The only other planned discharges we know of to be taken into account are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration. The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations. The metals listed in Table 1 are also in the FED effluent and discharge (b) also contains traces of chromium, copper, lead, nickel and zinc The fundamental reason we believe the three effluents will not have any significant adverse affects on the European sites 'in combination' is that the discharge in this assessment and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. As stated above 'insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three 'insignificant' discharges can combine to become significant. It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharge every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary. Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to have any significant adverse affect on the designated bird species of the European site or on any organisms that form part of their habitats or on which they

	feed. **The Environment Agency is minded to:** **Issue the permission with conditions to ensure no significant adverse affect on the designated species of the European site.** Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents. Permit Conditions The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge. The permit will also have conditions requiring the operator to self–monitor, record and report the metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped. **Your agreement to granting the variation is sought on this basis.**
EA Officer:	Bill Greenwood | **Date: 26/32/2016**
Natural England/CCW comment on assessment:	.
Natural England/CCW Officer:	| **Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).	

Part B Suggested scope of the EA appropriate assessment:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

Site map – Outlet and Outer Thames Estuary SPA highlighted.

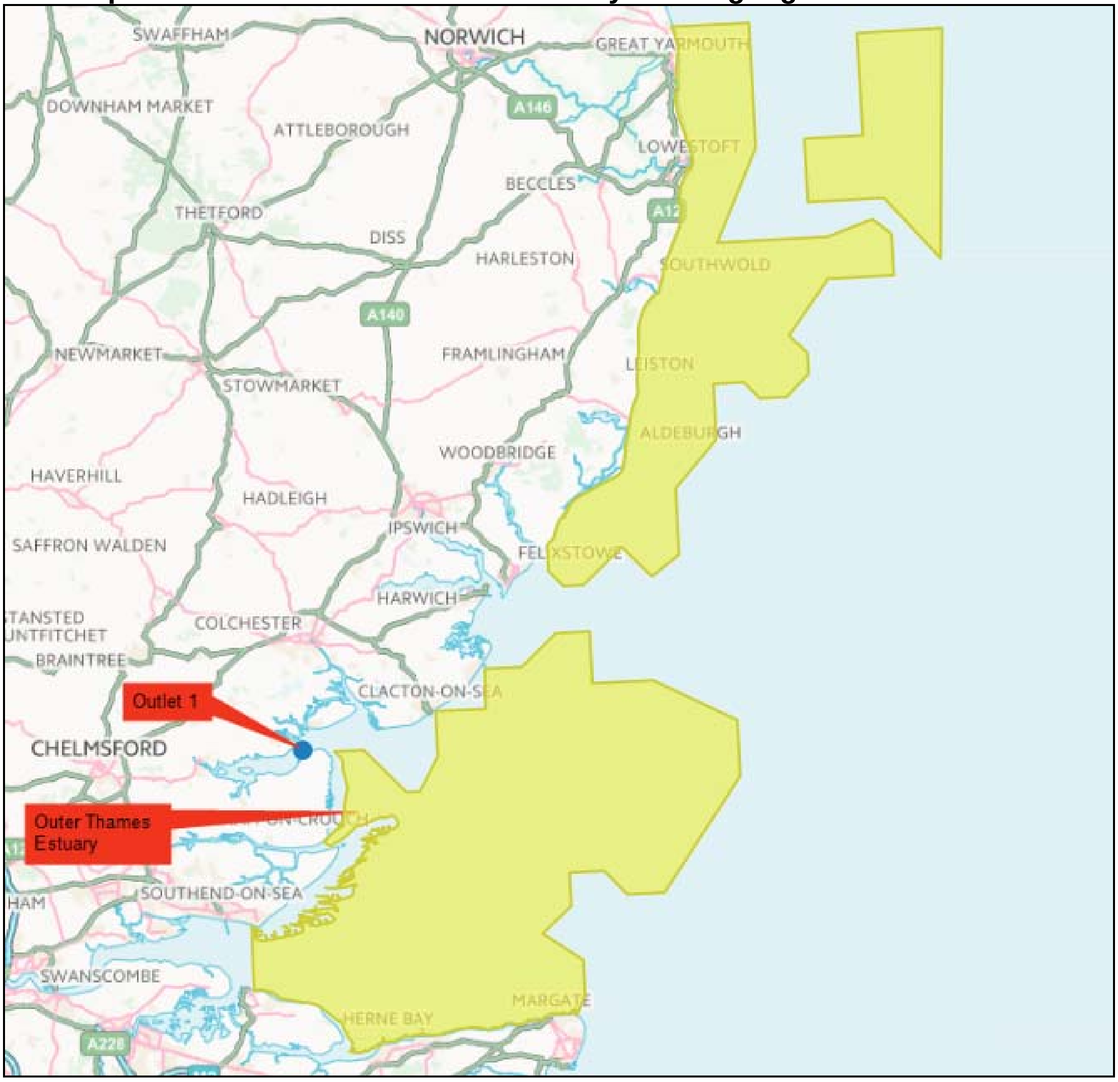


Table 1 - Metals concentrations in the treated radioactive site drainage effluent

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Extracts from Table 3 page 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 page 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108.

(23) Essex Estuaries SAC – Non Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)	
Type of permission/activity:	Discharge Consents
Environment Agency reference no:	PR2TS/E10760C
National grid reference:	TL 99650 09150

Habitats Assessment for an application to vary an EPR 'water discharge activity' permit PR2TS/E10760C.

Essex Estuaries SAC
(Based on the N.E. documents Conservation advice for Marine Conservation Zone: Essex Estuaries a draft copy of the 'Supplementary advice on conserving and restoring site features' for this SAC)

Name of EA Permitting Officer Bill Greenwood, National Permitting Service, Nottingham Permitting Centre

Date for Environment Agency permit determination 31/3/2016

Predicted 28 day date for NE response 28/3/2016

Date of submission of assessment 29/2/2016

Operator - Magnox Ltd, former nuclear power station site, Bradwell on Sea, Essex.
Discharge – Max 130 m3 a day (in dry weather) of mixed effluents (see below) (NGR - TL 99650 09150

Format of the Assessment Report
A condensed specification of the Conservation Objectives (CO's) is given below followed by a brief background to the proposed discharge and details of its volume and contents. Below this is an explanation of how we have assessed the potential for the polluting elements of the discharge to have an adverse affect on the designated features of the site and whether it would interfere with the relevant CO's. Finally there is a conclusion section explaining our 'minded to' permitting position.

Discharge – Max 130 m3 a day (in dry weather) of mixed effluents (see below

Component SSSI sites – Colne Estuary SSSI, Blackwater Estuary SSSI, Dengie SSSI, Foulness SSSI, Crouch and Roach Estuaries SSSI, The Cliff, Burnham On Crouch SSSI, Blackwater Estuary SSSI

Overlapping SPA/Ramsar sites – Colne Estuary(Mid-Essex Coast Phase-2), Blackwater Estuary (Mid-Essex Coast Phase-4), Dengie (Mid-Essex Coast Phase-1) Foulness (Mid-Essex Coast Phase-5), Crouch and Roach Estuaries (Mid-Essex Phase-3)

Overlapping MCZ's – Blackwater, Crouch, Roach and Colne Estuaries MCZ

Qualifying features and subfeatures

(1) Estuaries

The major estuaries of the Blackwater, Colne, Crouch and Roach as well as extensive open coast tidal flats at Foulness, Maplin and the Dengie

(1a) Intertidal rock

This subfeature has been indentified at a series of locations throughout the estuaries.

(1b) Sub-tidal mixed sediment

This subfeature has been identified in the upper reaches of the Blackwater estuary and from its midpoint to the estuary mouth. Also at the east side of the Colne estuary.

(1c) Subtidal mud

This subfeature is widely distributed throughout the site

(2) Mediterranean and thermo –Atlantic halophilus scrubs

This feature comprises 1.36 % of the saltmarshes of the Essex Estuaries site.

(3) Mudflats and sandflats not covered by sweater at low tide

This feature occurs throughout the site including in the Colne, Blackwater, Crouch and Roach estuaries and in the Maplin Sands, Foulness and Dengie.

(3a) Intertidal coarse sediment

This subfeature has been identified in the Blackwater estuary near West Mersea, in the Haybridge Basin, and west of Ramsey Island

(3b) Intertidal mixed sediments

This subfeature has been identified in the upper reaches of the Blackwater and also the east of Osea and on the north back of the Crouch upstream of Burnham.

(3d) Intertidal mud

This subfeature is abundant in all four estuaries of the site. It is present in the intertidal areas of the south and north banks of the Crouch, the Dengie Flats near Bradwell and west of Brightlingsea.

(3e) Intertidal sand and muddy sand

This subfeature is present at the northern and southern ends of the Maplin Sands the south bank of the outer Crouch and the upper reaches of the Blackwater estuary. Also in the Dengie Flats near Tillingham Marshes and near Bradwell

(3f) Intertidal seagrass beds

Recent records show this subfeature occurring both on the Maplin Sands and inside the MOD range at Shoeburyness

(4) Salicornia and other annuals colonising muds and sands

This feature can be found at most saltmarsh sites within the Essex Estuaries SAC.

(5) Spartina swards

This feature was identified in the following locations on the southern bank of the Blackwater estuary, from Maldon around to Maryland Creek near to Steeple, at Mundon Stone Point, Osea Island, in the bay north of Decoy point between Foulness Point down to Eastwick Head.

(6) Non –qualifying feature present: Sandbanks which are slightly covered by sea water all the time.

(6a) Subtidal coarse sediment

This subfeature is present in the mouth of the River Crouch

(6b) Subtidal sands

This subfeature is present in the mouth of the Colne and upper parts and mouth of the Crouch estuary. Also on the southern tip of Buxey Sand between the Ray Sands and Foulness Sands

(6c) Subtidal seagrass beds

This subfeature has been identified on sheltered muddy sands on Maplin Sands

Conservation Objectives

The site's conservation objectives apply to the Special Area of Conservation and the natural habitat and/or species for which the site had been designated ("Qualifying features)

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored, as appropriate, and that the site contributes to achieving the 'Favourable Condition Status, of its qualifying features by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species

- the structure and function (including typical features) of qualifying natural habitats
- the structure and function of the habitats of qualifying species
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- the distribution of qualifying species within the site

Definition of favourable condition
For each protected broad-scale habitat:
(1) The extent is stable or increasing and

(2) Its structure and functions its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate.

Any temporary deterioration in condition to be disregarded if the habitat is sufficiently resilient to enable recovery

For each species of marine fauna:
That the population within a zone is supported in numbers which enable it to thrive by maintaining :
(1) The quality and quantity of its habitat and

(2) The number, age and sex ratio of its population

Relevant Attributes and Targets
The relevant ecological characteristics (**attributes**) of the designated species and habitats and the appropriate water quality conditions (**targets**) that are necessary to safeguard them to meet the Conservation Objectives (CO's) for the SAC are listed in groups below By 'relevant' we mean that these are the attributes that could potentially be threatened by the contents of the proposed discharge. An example of non-relevant target for this discharge is, "Reduce the introduction and spread of non native species and pathogens and their impacts". This isn't relevant because the permit is to allow a discharge of trade effluent not to allow some form of shell fishery operation. Another example is, "Maintain the total organic carbon (TOC) content in the sediment at existing levels." This isn't relevant because the discharge does not contain any TOC.
Listing the appropriate targets to safeguard the CO's of the SAC's and grouping them into common types helps to condense this report, avoid too much repetition and focus on the essential issues.
The common attributes (supporting processes and structures) and targets for the above qualifying features and subfeatures are :

(1) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity.

(2) Water quality i.e turbidity

Maintain natural levels of turbidity (eg concentrations of suspended solid particulates .plankton and other material across the habitat. Turbidity levels can rise and fall rapidly as a result of biological (e.g. plankton blooms) physical (e.g. storms) or human (e.g. coastal development) factors.

(3) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from its existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which several heavy metals were recorded as being above Effects Range Low (ERL) threshold. The only heavy metal which may adversely impact aqueous contaminants recorded above the ERL was Mercury in the upper reaches of the River Crouch.

(4) Sediment contaminants

Reduce surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature
Restrict surface sediment contaminants levels to concentrations where they are not adversely impacting on the infauna of the feature. Various heavy metals are known to affect the species that live in or on the surface of the sediments. These include Hg, As, Zn, Ni, Ch, Cd, etc. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which several heavy metals were recorded as being above Effects Range Low (ERL) threshold.
Reduce surface sediment contaminants (<1cm from the surface) to below the OSPA Environmental Assessment Criteria (EAC) or ERL threshold. Various heavy metals are known to affect the species that live in or on the surface of the sediments. These include Hg, As, Zn, Ni, Ch, Cd, etc. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which several heavy metals were recorded as being above (ERL) thresholds.

Background to the application

The applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing.

The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radio nuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here.

In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also.

The requested changes to the permit are therefore:-

- to use the new outlet structure
- to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow.
- to have two discharges instead of one completely mixed effluent.

The two discharges will be:-

- A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage
- Treated radioactive site drainage

This consultation concerns the discharge the mixed effluents. The radioactive site drainage discharge will be addressed separately in another document for the sake of clarity.

Volume, rate, contents and discharge arrangement

One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.'

With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD) 30 mg/l of suspended solids (SS) and 20 mg/l of ammonia cal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300.000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for the sewage component of this effluent on any new permit if we granted one.

The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no significant traces of hazardous pollutants as can be readily understood since its source is tap water.

Treatment and discharge quality

The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range metals and their concentrations after the minimum 5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

Table 1 . Metals concentrations in mixed effluent discharge compared to EQS's

(Derived from Table 3 pg 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108)

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	**3.88**	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Key aim and principles of the assessment

The key aim of our assessment has been to determine whether the proposed discharge would cause any direct harm to any of the designated features within the SAC or whether it would prevent them being in 'favourable condition' as defined above. We have therefore tried to asses whether the

proposed discharge would prevent the features spreading and colonising new areas as well as whether it would harm them in their current locations.
The only polluting elements of the discharge that are in sufficient strength in the effluent to potentially cause harm within the SAC are the heavy metals it contains but we have considered its pH and suspended solids loads for the sake of completeness.
The criteria we have used for determining ''polluting strength' and the potential for causing harm are the relevant environmental quality standards (EQS's), and the existing background water quality in the receiving waters. These are incorporated into the screening exercises of our published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*,
The overall impact assessment has been greatly simplified in this case by the fact that all of the metals in the discharge screen out in as being 'insignificant' using the H1 criteria. In H 1 terms insignificant means that the concentrations would not threaten a breach of any EQS or WFD target or cause a significant increase in existing background concentrations outside the mixing zone.

- Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We can be confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be caused to any aquatic organisms or their habitat. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010**.**

- Acceptable Mixing Zones and the H1 screening tool

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.
The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones.
In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. All the metals the effluent is likely to contain screened out as being 'insignificant'.

Assessment of possible impacts on attributes and targets

(1) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity
The effluent will be discharge at ambient temperatures and will be non-saline. It is too small a volume

to influence the existing salinity regime even with the mixing zone.
The site drainage is alkaline however and the first treatment process it is subject to is pH adjustment so that the effluent will be in the standard pH range of 6-9 that the Agency routinely imposes on water discharge activity permits. There is no WFD target for pH in marine waters to judge polluting potential but there is an EC directive target for pH in marine waters of 7 to 9 for shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration.
The 20 m3 of treated site drainage will have a minimum dilution of 5.5:1 before discharge if the rainfall preceding it is minimal. So in relatively dry weather there will not be enough dilution to raise the pH from 6 to 7 within the mixed effluents. However because the outlet is 400 metres from the shore out into the central channel of the estuary and has been fixed at a point that is always below the lowest water of the lowest tide we can be certain that this effluent will always receive good levels of dilution. So even in the worst case scenario of a discharge following minimal rainfall to the lowest water level in the estuary we can be confident that the pH will be raised to 7 within a small mixing zone. Because the mixed effluents are buoyant we can also be sure that it will rise to the surface as it mixes and that no receptors on the estuary bed will be impacted even within a close proximity to the discharge point. For most of the time the treated site drainage will receive much greater dilution within the mixed effluents and within the estuary around the discharge point.
We are therefore confident that the background physiochemical properties of the Blackwater estuary waters will be maintained even in close proximity to the discharge point and that the discharge does not prose a threat to any designated features anywhere within the SAC from its salinity, temperature or pH characteristics.

(2) Water quality i.e turbidity

Water turbidity as a result of material suspended in the water including sediment, plankton, pollution or material washed into the estuary from the land.
The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant type for non –reactive site drainage can achieve around 50 mg/l. The waste waters from RO treatment and clean site drainage are likely to be much less and all four effluents will have some retention time for solids to settle out in the final chamber before settlement. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. Because the outlet for the discharge is 400 metres from the shore in the central channel of the estuary and a few metres above the estuary bed, but always under water even at the lowest tide, there will always be good dilution and dispersion for it. Because of this good mixing and because suspended solids concentrations will not exceed typically average estuarial concentrations we are confident that the discharge could have no adverse affect on any receptor anywhere within the SAC.

(3) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.
The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only potential threat to the interest features of the SSSI from toxic effects by the mixed effluents It can be seen from this table that the only metal that would exceed any EQS in the discharge is chromium. The annual average (AA) EQS for chromium is 0.6 ug/l and the average chromium concentrations recorded in the discharges is 3.88 ug/l. To prevent a long term chronic affect in the estuary the mixed effluent discharge would only have to receive just over 6:1 dilution which, (as explained above) is extremely likely to happen within a very short distance from the outlet even at the lowest tide and water level. However the MAC EQS for chromium is 32 ug/l so even before it mixes it could not have any direct toxic effect on any aquatic organism.
Because all the other metals are less than their EQS's within the discharge they screened out at the first criteria of the H1 methodology as being insignificant and it was only necessary to screen chromium any further. The second major H1 screening criteria confirms that this concentration of chromium is 'insignificant' and could not cause any harm to any of the receptors of the SAC outside of a very restricted mixing zone from short term or long term exposure to it. The fact that the effluent

is discharged a few metres above the estuary bed and is buoyant means that even within its mixing zone it could have no effect on native oysters or native oysters beds.
Strictly speaking the 'Reduce' target can not be met by allowing the discharge because allowing the input of even an insignificant load of metals could not qualify as a reduction. However allowing the discharge will not prevent the achievement of the 'Reduce' target at some time in the future if this is possible. A reduction within the wider SAC could only be achieved by removing other more significant discharges from the estuary catchment.

(4) Sediment contaminants

Restrict surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.
The processes by which the metals within the water column of the receiving estuary are deposited onto sediments on the estuary bed are too many and complex to calculate what amounts would accumulate within them over time. But it is common sense that, (whatever the processes are) if the existing background concentration of metals in the water column does not change significantly, then the amounts deposited in the sediments could not change significantly either.
As stated in the above section the H1 screening process give us confidence that the existing background concentrations of metals in the receiving Blackwater estuary will not be significantly changed outside a very limited mixing zone as a result of this discharge taking place. On the principle that, if the background concentrations of metals don't significantly change in the water column, the load of sediments accumulating in sediments won't significantly change either, we are therefore confident that allowing the discharge will not threaten a breach of the above target.

Potential 'In combination' affects
On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries.
The only other planned discharges we know of to be taken into account for this assessment are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of treated radioactive site drainage.
The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations.
The fundamental reason we believe the three effluents will not have any significant adverse affects on the above targets and attributes of the SAC is that this discharge and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. Insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three insignificant' discharges can combine to make a significant difference to the existing background water quality regime in the receiving Blackwater estuary or the other water bodies of the SAC beyond it.
It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharged every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary.

Conclusion
Given the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to threaten any of the targets or attributes that safeguard the CO's of the SAC.
Our aim has been to assess whether this existing discharge made from a new outlet has the potential to adversely impact upon any designated feature of the SAC or their supporting habitats in their current location, or whether they would prevent the spread or colonisation of them to new areas. We have done this by considering what the zone of potential adverse affect the polluting load from the

discharge creates within the receiving estuary.
In this case this zone is extremely limited to a small area around the discharge point. We can not define its dimensions but the H1 screening exercise establishes that it is ‘acceptable’.
We are therefore confident that if we allowed the discharge to be made from the new outlet there would be no significant adverse impact on any of the designated features anywhere within the SAC.
On this basis the Agency is minded to:

Issue the permission with conditions to ensure no significant adverse affect on the designated features of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to take some occasional routine audit sample and report the concentrations of metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis

EA Officer:	Bill Greenwood	**Date: 29/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**
If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).		

Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

(24) Essex Estuaries SAC – Radioactive site drainage

Habitats Directive: Form for recording likely significant effect (Stage 2)	Environment Agency
For consultation	
Part A **Permitting officer to complete this section in consultation with Conservation/Ecology section and Natural England/Countryside Council for Wales (CCW)**	
Type of permission/activity:	Discharge Consents
Environment Agency reference no:	PR2TS/E10760C
National grid reference:	TL 99650 09150

Habitats Assessment for an application to vary an EPR 'water discharge activity' permit PR2TS/E10760C.

Essex Estuaries SAC
(Based on the N.E. documents Conservation advice for Marine Conservation Zone: Essex Estuaries a draft copy of the 'Supplementary advice on conserving and restoring site features' for this SAC)

Name of EA Permitting Officer Bill Greenwood, National Permitting Service, Nottingham Permitting Centre

Date for Environment Agency permit determination 31/3/2016

Predicted 28 day date for NE response 28/3/2016

Date of submission of assessment 29/2/2016

Operator - Magnox Ltd, former nuclear power station site, Bradwell on Sea, Essex.
Discharge – Max 130 m3 a day (in dry weather) of mixed effluents (see below) (NGR - TL 99650 09150

Format of the Assessment Report
A condensed specification of the Conservation Objectives (CO's) is given below followed by a brief background to the proposed discharge and details of its volume and contents. Below this is an explanation of how we have assessed the potential for the polluting elements of the discharge to have an adverse affect on the designated features of the site and whether it would interfere with the relevant CO's. Finally there is a conclusion section explaining our 'minded to' permitting position.

Discharge – Max 30 m3 a day of treated radioactive site drainage effluent.

Component SSSI sites – Colne Estuary SSSI, Blackwater Estuary SSSI, Dengie SSSI, Foulness SSSI, Crouch and Roach Estuaries SSSI, The Cliff, Burnham On Crouch SSSI, Blackwater Estuary SSSI

Overlapping SPA/Ramsar sites – Colne Estuary(Mid-Essex Coast Phase-2), Blackwater Estuary (Mid-Essex Coast Phase-4), Dengie (Mid-Essex Coast Phase-1) Foulness (Mid-Essex Coast Phase-5), Crouch and Roach Estuaries (Mid-Essex Phase-3)

Overlapping MCZ's – Blackwater, Crouch, Roach and Colne Estuaries MCZ

Qualifying features and subfeatures
(1) Estuaries
This feature is the major estuaries of the Blackwater, Colne, Crouch and Roach as well as extensive open coast tidal flats at Foulness, Maplin and the Dengie
(1a) Intertidal rock
This subfeature has been indentified at a series of locations throughout the estuaries.
(1b) Sub-tidal mixed sediment
This subfeature has been identified in the upper reaches of the Blackwater estuary and from its midpoint to the estuary mouth. Also at the east side of the Colne estuary.
(1c) Subtidal mud
This subfeature is widely distributed throughout the site
(2) Mediterranean and thermo –Atlantic halophilus scrubs
This feature comprises 1.36 % of the saltmarshes of the Essex Estuaries site.
(3) Mudflats and sandflats not covered by sweater at low tide
This feature occurs throughout the site including in the Colne, Blackwater, Crouch and Roach estuaries and in the Maplin Sands, Foulness and Dengie.
(3a) Intertidal coarse sediment
This subfeature has been identified in the Blackwater estuary near West Mersea, in the Haybridge Basin, and west of Ramsey Island
(3b) Intertidal mixed sediments
This subfeature has been identified in the upper reaches of the Blackwater and also the east

of Osea and on the north back of the Crouch upstream of Burnham.

(3d) Intertidal mud

This subfeature is abundant in all four estuaries of the site. It is present in the intertidal areas of the south and north banks of the Crouch, the Dengie Flats near Bradwell and west of Brightlingsea.

(3e) Intertidal sand and muddy sand

This subfeature is present at the northern and southern ends of the Maplin Sands the south bank of the outer Crouch and the upper reaches of the Blackwater estuary. Also in the Dengie Flats near Tillingham Marshes and near Bradwell

(3f) Intertidal seagrass beds

Recent records show this subfeature occurring both on the Maplin Sands and inside the MOD range at Shoeburyness

(4) Salicornia and other annuals colonising muds and sands

This feature can be found at most saltmarsh sites within the Essex Estuaries SAC.

(5) Spartina swards

This feature was identified in the following locations on the southern bank of the Blackwater estuary, from Maldon around to Maryland Creek near to Steeple, at Mundon Stone Point, Osea Island, in the bay north of Decoy point between Foulness Point down to Eastwick Head.

(6) Non –qualifying feature present: Sandbanks which are slightly covered by sea water all the time.

(6a) Subtidal coarse sediment

This subfeature is present in the mouth of the River Crouch

(6b) Subtidal sands

This subfeature is present in the mouth of the Colne and upper parts and mouth of the Crouch estuary. Also on the southern tip of Buxey Sand between the Ray Sands and Foulness Sands

(6c) Subtidal seagrass beds

This subfeature has been identified on sheltered muddy sands on Maplin Sands

Conservation Objectives for each of the designated features

The site's conservation objectives apply to the Special Area of Conservation and the natural habitat and/or species for which the site had been designated ("Qualifying features)

The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored, as appropriate, and that the site contributes to achieving the 'Favourable Condition Status, of its qualifying features by maintaining or restoring:

- the extent and distribution of qualifying natural habitats and habitats of the qualifying species
- the structure and function (including typical features) of qualifying natural habitats
- the structure and function of the habitats of qualifying species
- the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- the distribution of qualifying species within the site

Definition of favourable condition

For each protected broad-scale habitat:

(3) The extent is stable or increasing and

(4) Its structure and functions its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate.

Any temporary deterioration in condition to be disregarded if the habitat is sufficiently resilient to enable recovery

For each species of marine fauna:
That the population within a zone is supported in numbers which enable it to thrive by maintaining :

(3) The quality and quantity of its habitat and

(4) The number, age and sex ratio of its population

Relevant Attributes and Targets
The relevant ecological characteristics (**attributes**) of the designated species and habitats and the appropriate water quality conditions (**targets**) that are necessary to safeguard them to meet the Conservation Objectives (CO's) for the SAC are listed in groups below By 'relevant' we mean that these are the attributes that could potentially be threatened by the contents of the proposed discharge. An example of non-relevant target for this discharge is, "Reduce the introduction and spread of non native species and pathogens and their impacts". This isn't relevant because the permit is to allow a discharge of trade effluent not to allow some form of shell fishery operation. Another example is, "Maintain the total organic carbon (TOC) content in the sediment at existing levels." This isn't relevant because the discharge does not contain any TOC.
Listing the appropriate targets to safeguard the CO's of the SAC's and grouping them into common types helps to condense this report, avoid too much repetition and focus on the essential issues. The common attributes (supporting processes and structures) and targets for the above qualifying features and subfeatures are :

(5) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity.

(6) Water quality i.e turbidity

Maintain natural levels of turbidity (eg concentrations of suspended solid particulates .plankton and other material across the habitat. Turbidity levels can rise and fall rapidly as a result of biological (e.g. plankton blooms) physical (e.g. storms) or human (e.g. coastal development) factors.

(7) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from its existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which several heavy metals were recorded as being above Effects Range Low (ERL) threshold. The only heavy metal which may adversely impact aqueous contaminants recorded above the ERL was Mercury in the upper reaches of the River Crouch.

(8) Sediment contaminants

Reduce surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature
Restrict surface sediment contaminants levels to concentrations where they are not adversely impacting on the infauna of the feature. Various heavy metals are known to affect the species that live in or on the surface of the sediments. These include Hg, As, Zn, Ni, Ch, Cd, etc. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which several heavy metals were recorded as being above Effects Range Low (ERL) threshold.
Reduce surface sediment contaminants (<1cm from the surface) to below the OSPA Environmental Assessment Criteria (EAC) or ERL threshold. Various heavy metals are known to affect the species that live in or on the surface of the sediments. These include Hg, As, Zn, Ni, Ch, Cd, etc. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which several heavy metals were recorded as being above (ERL) thresholds.

Background to the application
The applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of

November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing.
The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radio nuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here.
In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also.
The requested changes to the permit are therefore:-

- to use the new outlet structure
- to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow.
- to have two discharges instead of one completely mixed effluent.

The two discharges will be:-

- A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage
- Treated radioactive site drainage

This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licenced under a different permit, EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity.

Volume, rate, contents and discharge arrangement
The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH 12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an ‘aqueous abatement plant’. The plant utilises pH adjustment membrane filtration, absorption with granular active carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 below outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS’s.
The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.

Table 1 - Metals concentrations in the treated radioactive site drainage effluent (Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Key aim and principles of the assessment

The key aim of our assessment has been to determine whether the proposed discharge would cause any direct harm to any of the designated features within the SAC or whether it would prevent them being in 'favourable condition' as defined above. We have therefore tried to asses whether the proposed discharge would prevent the features spreading and colonising new areas as well as whether it would harm them in their current locations.

The only polluting elements of the discharge that are in sufficient strength in the effluent to potentially cause harm within the SAC are several heavy metals it contains but we have considered its pH also for the sake of completeness.

The criteria we have used for determining ''polluting strength' and the potential for causing harm are the relevant environmental quality standards (EQS's), WFD targets and existing background water quality in the receiving waters. The evidence for the predicted pathways the discharge will take within the receiving waters, and the dilutions it will be subject to, come from the H1 screening exercises and the dispersion modelling undertaken by the applicant's consultants HR Wallingford. These have been vetted by members of our Estuarine Coastal Monitoring and Assessment Service (ECMAS) team and after some clarification the main results accepted.

The assessment has been simplified in this case by the fact all of the metals in the discharge screen out in as being 'insignificant' following H1 criteria and the modelling information supplied by HR Wallingford confirms that all relevant EQS targets are met outside the initial mixing zone.

- Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure hat marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We can be confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be caused to any aquatic organisms or their habitat. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010**.**

- Acceptable Mixing Zones and the H1 screening tool

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.
The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

- Modelling in support of the application

Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1.

- Pathways and receptors

As stated above the modelling undertaken by HR Wallingford and vetted by members of our ECMAS team established the dilution factors that the effluent will be subject to within an 'initial dilution' mixing zone 100 metres from the discharge point downstream on the ebbing tide. This approach establishes that the maximum zone of influence the pollutants within the discharge could have is limited to this 100 metre plume rising from the outlet 5.5 metres above the estuary bed to the surface. Because the effluent passes the H1 screening tests the EQS's for individual metals would probably be met well within this distance but the modelling does establish the worst case scenario of 100 metres.

Assessment of possible impacts on attributes and targets

Incorporating the principles and information given above our assessment of the potential for the discharge to impact on the relevant attributes and targets (listed above) which safeguard the CO's of the SAC are addressed below in turn

(5) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity

The effluent will be discharge at ambient temperatures and will be non-saline. It is too small a volume to influence the existing salinity regime even with the mixing zone.
The site drainage is alkaline however and the first treatment process it is subject to is pH adjustment so that the effluent will be in the standard pH range of 6-9 that the Agency routinely imposes on water discharge activity permits. There is no WFD target for pH in marine waters to judge polluting potential but there is an EC directive target for pH in marine waters of 7 to 9 for shellfish for human consumption. This does not strictly apply to SSSI's habitats but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 250:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7. Because the effluent is buoyant it will rise to the surface, so there is no danger of any affect on any receptor beyond the 100 metre mixing zone and none on any receptor on the estuary bed even within it.
The physio-chemical properties of the receiving Blackwater estuary would therefore not be changed outside the initial dilution mixing zone and even within this zone the affects would be limited to slight changes of pH within the effluent plume around the discharge point. There is therefore no threat from pH characteristics of the discharge to native oysters or native oyster beds even within the mixing zone and definitely none outside it.

(6) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.
The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only potential threat to the interest features of the SSSI from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.
This test as outlined in Annexe D1 of H1 uses a formula to calculate if the mixing zone for a particular substances is 'allowable'. It uses the discharge rates and concentration of the substance as well as the appropriate EQS's and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS's used in the applicant's assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.
In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS's and 16,800:1 for AA EQS's is more than sufficient to prevent any breach of EQS's outside the mixing zone.
We can therefore be confident that the proposed discharge from the new outlet would not cause any harm to any receptor outside the initial 100 metre mixing zone. Because the metals in the effluent passed the H1 screening test it is probable that the relevant EQS for each is met well within 100 metres but the modelling demonstrates that 100 metres is the worst case scenario. Because the effluent is buoyant it will not come into contact within any receptors or features on the estuary bed even within the mixing zone.
Strictly speaking the 'Reduce' target can not be met by allowing the discharge because allowing the input of even an insignificant load of metals could not qualify as a reduction. However allowing the discharge will not prevent the achievement of the 'Reduce' target at some time in the future if this is possible. A reduction within the wider SAC could only be achieved by removing other more significant discharges from the estuary catchment.

(7) Sediment contaminants

Restrict surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.
The processes by which the metals within the water column of the receiving estuary are deposited onto sediments on the estuary bed are too many and complex to calculate what amounts would

accumulate within them over time. But it is common sense that, (whatever the processes are) if the existing background concentration of metals in the water column does not change significantly, then the amounts deposited in the sediments could not change significantly either.
As stated in the above section the H1 Screening process and the modelling reports the applicant provided give us confidence that the existing background concentrations of metals in the receiving Blackwater estuary will not be significantly changed outside the 100 metre mixing zone as a result of this discharge taking place. On the principle that, if the background concentrations of metals don't significantly change in the water column, the load of sediments accumulating in sediments won't significantly change either, we don't think the discharge would have any significant adverse affects on any receptors within the SAC outside the mixing zone. The potential for a significant affect even within the mixing zone is limited because the discharge will always be made around the high water time on an ebbing tide. It will therefore always be diluted and dispersed extremely quickly and the likelihood of any of the metals within it being deposited onto the sediments on the estuary bed is small.
We are therefore confident that allowing the discharge will not threaten a breach of the above target anywhere within the SAC.

Potential 'In combination' affects
On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries.
The only other planned discharges we know of to be taken into account for this assessment are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration.
The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations.
The fundamental reason we believe the three effluents will not have any significant adverse affects on the above targets and attributes of the SAC is that this discharge and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. Insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three insignificant' discharges can combine to make a significant difference to the existing background water quality regime in the receiving Blackwater estuary or the other water bodies of the SAC beyond it.
It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharged every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary.
Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to threaten any of the targets or attributes that safeguard the CO's of the SAC.

CONCLUSION
Our aim has been to assess whether this existing discharge from the new outlet has the potential to adversely affect any designated feature of the SAC or their supporting habitats in their current location, or whether they would prevent the spread or colonisation of them to new areas. We have done this by considering what the zone of potential adverse affect the polluting load from the discharge creates within the receiving estuary.
In this case this zone is extremely limited. At worst it is within a buoyant plume of effluent extending up to 100 metres from the discharge point downstream on the ebbing tide. The only designated features which could be affected within the entire SAC are within this very limited zone of the Blackwater estuary. There is definitely no risk to any features of the Colne Crouch or Roach estuaries or those of the Foulness or the Cliff at Burnham on Sea SSSI's which are very remote from the

discharge point. The nearest receptors of the Dengie SSSI are more than 400 metres from the discharge point beyond the mixing zone and away from the dispersion plume which the HR Wallingford modelling established to be in the central channel of the Blackwater directed towards the open sea on the ebbing tide.

On this basis the Agency is minded to:

Issue the permission with conditions to ensure no significant adverse affect on the designated features of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency’s standard for all discharges. There will be a ‘no visible oil’ descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to take occasional audit samples of the discharge and report the metals concentrations to us. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis

EA Officer:	Bill Greenwood	**Date: 29/2/2016**
Natural England/CCW comment on assessment:	.	
Natural England/CCW Officer:		**Date:**

If there is a likely significant effect, an appropriate assessment will be required (see part B for suggested scope).

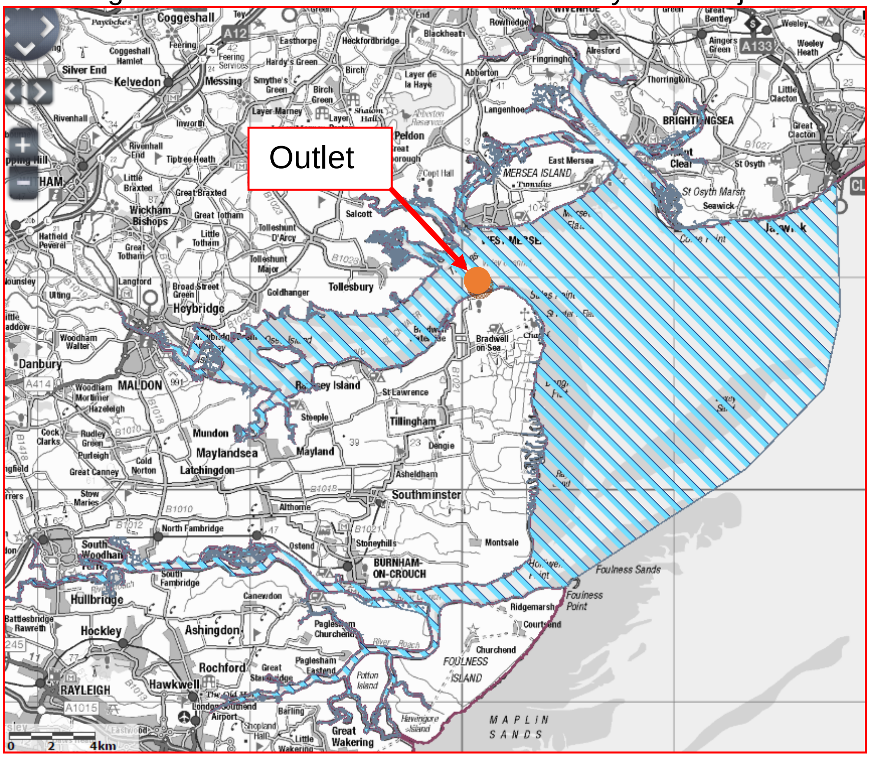
Part B **Suggested scope of the EA appropriate assessment**:		
Add details to following framework • Other competent authorities involved • Characterise the site in relation to the qualifying features and their conservation objectives; - existing information - additional surveys - management/unauthorised impacts • Detailed description of plan/project • Assess each likely impact on the interest features; - compare with historical data - predict impacts - compare with impact from management/unauthorised activities • Determine the extent to which each possible impact can be avoided.		
Natural England/CCW comment on scope of EA appropriate assessment:		
Natural England/CCW Officer:		**Date:**

(25) Blackwater,Colne, Crouch and Roach Estuaries MCZ – Non Radioactive site drainage.

Habitats Assessment for an application to vary a 'water discharge activity' permit PR2TSE10760
Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone
(Based on the N.E. documents Conservation advice for Marine Conservation Zone: Blackwater, Crouch, Roach and Colne Estuaries (BS 03) and a draft copy of the 'Supplementary advice on conserving and restoring site features' for this MCZ)
Name of EA Permitting Officer Bill Greenwood, National Permitting Service, Nottingham Permitting Centre
Date for Environment Agency permit determination 31/3/2016
Predicted 28 day date for NE response 28/3/2016
Date of submission of assessment 29/2/2016
Operator - Magnox Ltd, former nuclear power station site, Bradwell on Sea, Essex.
Discharge – Max 130 m3 a day (in dry weather) of mixed effluents (see below)
NGR - TL 99650 09150
Format of the assessment report - A condensed specification of the Conservation Objectives (CO's) is given below followed by a brief background to the proposed

discharge and details of its volume and contents. Below this is an explanation of how we have assessed the potential for the polluting elements of the discharge to hinder, or not, the conservation objectives of the site. Finally there is a conclusion section explaining our ‘minded to’ permitting position.

Designation Area - The MCZ is located on the Essex Coast extending from the mean high water mark to where the four estuary mouths join the North Sea



Component SSSI sites – Colne Estuary SSSI, Blackwater Estuary SSSI, Dengie SSSI, Foulness SSSI, Crouch and Roach Estuaries SSSI, The Cliff, Burnham On Sea SSSI, Clacton Cliffs and Foreshore SSSI

Overlapping SPA/Ramsar sites – Colne Estuary(Mid-Essex Coast Phase-2), Blackwater Estuary (Mid-Essex Coast Phase-4), Dengie (Mid-Essex Coast Phase-1) Foulness (Mid-Essex Coast Phase-5), Crouch and Roach Estuaries (Mid-Essex Phase-3)

Overlapping MCZ’s – Essex Estuaries MCZ

Designation Features – (i) intertidal mixed sediment (ii) Native oyster beds, (iii) Native oysters (Ostrea edulis)

(iv) Clifton Cliffs and Foreshore – ***Note*** – *Because this feature is purely geological the only affects the discharge could have on it would be physical damage if it changed the flow regime in the vicinity. But the discharge is too small (Max 130 m3 in dry weather) and too far (16 km) from the feature to have any physical affect upon it. This feature is therefore excluded from the any further assessment.*

Location of the designated features

Native Oysters are known to occur throughout the four component rivers with distributions of wild populations predominantly clustered around the sublitoral parts of the outer Blackwater and Colne estuaries the Ray Sound Channel and the outer Crouch estuary.

Native Oyster beds

Established beds have been recorded in the the sublitoral parts of the Ray Sand Channel and the outer Blackwater area near Mersea Island.

Intertidal Mixed Sediment has been identified in the Blackwater to the east of Osea Island and the upper reaches of the Blackwater. It was also identified on the north bank of the Crouch upstream of Burnham.

Conservation Objectives for each of the designated features

(1) The features are maintained in favourable condition if they are already in favourable condition
(2) Be brought into favourable condition if they are not already in favourable condition

Definition of favourable condition
For each protected broad-scale habitat:
(5) The extent is stable or increasing and
(6) Its structure and functions its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate.

Any temporary deterioration in condition to be disregarded if the habitat is sufficiently resilient to enable recovery

For each species of marine fauna:
That the population within a zone is supported in numbers which enable it to thrive by maintaining:
(5) The quality and quantity of its habitat and
(6) The number, age and sex ratio of its population

Any temporary reduction in numbers of a species is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery

Relevant Attributes and Targets
The relevant ecological characteristics (**attributes**) of the designated species and habitats and the appropriate water quality conditions (**targets**) that are necessary to safeguard them to meet the Conservation Objectives (CO's) for the MCZ are listed in groups below By 'relevant' we mean that these are the attributes that could potentially be threatened by the contents of the proposed discharge. An example of non-relevant target for this discharge is, "Reduce the introduction and spread of non native species and pathogens and their impacts". This isn't relevant because the permit is to allow a discharge of trade effluent not to allow some form of shell fishery operation. Another example is, "Maintain the total organic carbon (TOC) content in the sediment at existing levels." This isn't relevant because the discharge does not contain any TOC.

Listing the appropriate targets to safeguard the CO's of the MCZ's and grouping them into common types helps to condense this report, avoid too much repetition and focus on the essential issues.

The common attributes (supporting processes and structures) and targets for Native Oysters, Native Oyster Beds and Intertidal mixed sediments are:

(1) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity.

(2) Hydrodynamic and physical conditions

Maintain the hydrodynamic and physical conditions

(3) Water quality i.e turbidity

Water turbidity as a result of material suspended in the water including sediment, plankton, pollution or material washed into the estuary from the land.

(4) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels

(5) Sediment contaminants

Restrict surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.

Background to the application

The applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing.

The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radio nuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here.

In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure includes four much smaller pipes for this discharge which are higher in the water column that the existing outlet. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also.

The requested changes to the permit are therefore:-

- to use the new outlet structure
- to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow.
- to have two discharges instead of one completely mixed effluent.

The two discharges will be:-

- A mixture of (i) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage
- Treated radioactive site drainage

This consultation concerns the discharge of the mixed effluents. The discharge of radioactive site drainage will be addressed in another document for the sake of clarity.

Volume, rate, contents and discharge arrangement

One important point to clarify about the mixed effluent discharge is that because it contains the element of clean uncontaminated site drainage the maximum volume discharged on any one day will vary greatly. It will be rainfall dependent but with the maximum and minimum volumes determined by pump settings. All the effluents mentioned above [(i) - (iv)] drain to a common chamber which is mainly to retain rainfall runoff. Pumps in the chamber are automatically activated by a float switch at a certain water level and will discharge 130 m3 until there is further ingress to trigger any further pumping. If there is no further ingress on the day because of dry weather there will be no further discharge. So 130 m3 is the maximum daily volume in dry weather. The maximum possible discharge on any one day is 50,000 m3 because this is the maximum capacity of the pumps. The rate of discharge is 303 litres per second (l/s). This high rate means that 130 m3 can be discharged in twenty minutes and because pumping is automatic the discharges could be made on all tidal states. Obviously the greater the amounts of surface water runoff draining to the chamber in wet weather the greater will be the dilution of the treated site drainage effluent before discharge. But in dry weather the 20 m3 of site drainage effluent may only be diluted by a factor of 5.5:1. It is this 'worst case scenario' discharge of minimum dilution prior to discharge that we will address here and if we grant a permit it will have a volume condition expressed as '130 m3 in dry weather conditions.'

With regards to contents, as stated above, it is only the treated site drainage that has the potential to contain significant concentrations of pollutants in the form of various heavy metals. The secondary treated sewage which will be up to a maximum of 30 m3 a day is from the package sewage treatment plant serving the on site workforce. It is therefore domestic only sewage with no inputs of hazardous pollutants from any trade process. It provides standard levels of treatment which will achieve emission limits of 20 milligrams per litre (mg/l) of biochemical oxygen demand (BOD), 30 mg/l of suspended solids (SS) and 20 mg/l of ammoniacal nitrogen but these will receive a minimum dilution of 3.3:1 in the other effluents before discharge. If there is moderate to high rainfall the dilutions before discharge will be much greater. Because of the massive dilution in the receiving estuary (the Blackwater estuary has an average volume of 106,300.000 m3) such a small volume of treated sewage does not have the potential to cause any harm to any receptors and accordingly there are no emission limits relating to it in the existing permit. For the same reason we would not impose emission limits for the sewage component of this effluent on any new permit if we granted one.

The only significant effect we consider the sewage effluent can have is to provide some useful dilution of the treated site drainage in dry weather. The same principle applies to the 'trade effluent derived from water treatment' component of the mixed effluent. This is in fact waste waters from a reverse osmosis treatment plant which is used on site to pre-treat tap water before it is used in one of the other treatment plants. It is only 5 cubic metres a day in volume and will contain no significant traces of hazardous pollutants as can be readily understood since its source is tap water.

Treatment and discharge quality

The source of the contaminated site drainage is rainfall runoff and void waters from non radioactive areas of the site where there is debris in the form of crushed concrete and waste metals. Rainwater mixing with the crushed concrete can become strongly alkaline over time and can dissolve waste metals within it. The treatment plant neutralises the pH causing the metals to drop out of solution and there is also filtration and settlement to enhance further removal. The resulting effluent is in the neutral pH range with residual concentrations of various metals. Table 1 below shows the range metals and their concentrations after the minimum

5.5:1 dilution they will receive in the other effluents before discharge. It also compares these with the relevant EQS's. As stated above this is a worst-case situation and in wet weather with greater dilution the metals concentrations will be much lower.

Table 1. Metals concentrations in mixed effluent discharge compared to EQS's

(Derived from Table 3 pg 6 of Env Risk Assessment in Support of Aqueous Effluent BRAD/EN/REP/108)

Substance	Maximum concentration in effluent after dilution in other effluents (ug/l)	EQS MAC (ug/l)	Average concentration in effluent after dilution in other effluents (ug/l)	EQS AA (ug/l)
Chromium	6.77	32	**3.88**	0.6
Copper	11.54	N/A	3.23	3.76
Lead	1.54	14	0.46	1.3
Nickel	4.92	34	1.54	8.6
Zinc	5.23	N/A	1.54	7.9
Arsenic	1.08	N/A	1.08	25

Key aim and principles of the assessment

The key aim of our assessment has been to determine whether the proposed discharge would cause any direct harm to any of the designated features within the MCZ or whether it would prevent them being in 'favourable condition' as defined above. We have therefore tried to asses whether the proposed discharge would prevent the features spreading and colonising new areas as well as whether it would harm them in their current locations.

The only polluting elements of the discharge that are in sufficient strength in the effluent to potentially cause harm within the MCZ are the heavy metals it contains but we have considered its pH and suspended solids loads for the sake of completeness.

The criteria we have used for determining ''polluting strength' and the potential for causing harm are the relevant environmental quality standards (EQS's), and the existing background water quality in the receiving waters. These are incorporated into the screening exercises of our published guidance document *'H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*,

The overall impact assessment has been greatly simplified in this case by the fact that all of the metals in the discharge screen out in as being 'insignificant' using the H1 criteria. In H1 terms insignificant means that the concentrations would not threaten a breach of any EQS or WFD target or cause a significant increase in existing background concentrations outside the mixing zone.

- Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure that marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We can be confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be caused to any aquatic organisms or their habitat. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010**.**

- Acceptable Mixing Zones and the H1 screening tool

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.
The Agency's published guidance document ' *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being 'insignificant' it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones.
In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid. All the metals the effluent is likely to contain screened out as being 'insignificant'.

Assessment of possible impacts on attributes and targets

Incorporating the principles and information given above our assessment of the potential for the discharge to impact on the relevant attributes and targets (listed above) which safeguard the CO's of the MCZ are addressed below in turn.

(8) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity
The effluent will be discharge at ambient temperatures and will be non-saline. It is too small a volume to influence the existing salinity regime even with the mixing zone. The site drainage is alkaline however and the first treatment process it is subject to is pH adjustment so that the effluent will be in the standard pH range of 6-9 that the Agency routinely imposes on water discharge activity permits. There is no WFD target for pH in marine waters to judge polluting potential but there is an EC directive target for pH in marine waters of 7 to 9 for shellfish for human consumption. This does not strictly apply to conservation sites but is worth some consideration.
The 20 m3 of treated site drainage will have a minimum dilution of 5.5:1 before discharge if the rainfall preceding it is minimal. So in relatively dry weather there will not be enough dilution to raise the pH from 6 to 7 within the mixed effluents.

However because the outlet is 400 metres from the shore out into the central channel of the estuary and has been fixed at a point that is always below the lowest water of the lowest tide we can be certain that this effluent will always receive good levels of dilution. So even in the worst case scenario of a discharge following minimal rainfall to the lowest water level in the estuary we can be confident that the pH will be raised to 7 within a small mixing zone. Because the mixed effluents are buoyant we can also be sure that it will rise to the surface as it mixes and that no receptors such as native oysters will be impacted upon even within a close proximity to the discharge point. For most of the time the treated site drainage will receive much greater dilution within the mixed effluents and within the estuary around the discharge point.
We are therefore confident that the background physiochemical properties of the Blackwater estuary waters will be maintained even in close proximity to the discharge point and that the discharge does not prose a threat to any designated features anywhere within the MCZ from its salinity, temperature or pH characteristics.

(9) Hydrodynamic and physical conditions

Maintain the hydrodynamic and physical conditions

The minimum daily volume of the discharge is too small (130 m3) in relation to the flows in the receiving estuary (average volume 106,300,000 m3) to have any affect on the existing background hydrodynamic and physical conditions within it. The maximum daily volume (50,000 m3) will only be to be discharged following very heavy rainfall when the volume of water in the estuary will be higher due to the same rainfall event. In fact the discharge will just be part of the natural hydrodynamic cycle of the Blackwater estuary catchment even though the site drains artificially through man made drains, collection systems and pumps. As such the discharge of mixed effluents could not threaten the above target.
The existing permit allows a discharge of up to 500,000 m3 a day so the application is for an improvement to the existing situation.

(10) Water quality i.e turbidity

Water turbidity as a result of material suspended in the water including sediment, plankton, pollution or material washed into the estuary from the land.

The combined turbidity of the mixed effluents will be average in relation to the typical turbidity levels within a dynamic estuary. The package sewage treatment plant is designed to achieve suspended solids of 30 mg/l and the treatment plant type used for non-radioactive site drainage can achieve around 50 mg/l. The waste waters from RO treatment and clean site drainage are likely to be much less and all four effluents will have some retention time for solids to settle out in the final chamber before settlement. The Agency's Site Plan Report of 2009 states that average suspended particulate matter concentrations in the Blackwater Estuary range from 16 to 99.6 mg/l and that this fits in with mean annual average values around the English and Welsh Coast. Because the outlet for the discharge is 400 metres from the shore in the central channel of the estuary and a few metres above the estuary bed, but always under water even at the lowest tide, there will always be good dilution and dispersion for it. Because of this good mixing and because suspended solids concentrations will not exceed typically average estuarial concentrations we are confident that the discharge could have no adverse affect on any receptor anywhere within the MCZ.

(11) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.

The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only potential threat to the interest features of the SSSI from toxic effects by the mixed effluents It can be seen from this table that the only metal that would exceed any EQS in the discharge is chromium. The annual average (AA) EQS for chromium is 0.6 ug/l and the average chromium concentrations recorded in the discharges is 3.88 ug/l. To prevent a long term chronic affect in the estuary the mixed effluent discharge would only have to receive just over 6:1 dilution which, (as explained above) is extremely likely to happen within a very short distance from the outlet even at the lowest tide and water level. However the MAC EQS for chromium is 32 ug/l so even before it mixes it could not have any direct toxic effect on any aquatic organism.

Because all the other metals are less than their EQS's within the discharge they screened out at the first criteria of the H1 methodology as being insignificant and it was only necessary to screen chromium any further. The second major H1 screening criteria confirms that this concentration of chromium is 'insignificant' and could not cause any harm to any of the receptors of the MCZ outside of a very restricted mixing zone from short term or long term exposure to it. The fact that the effluent is discharged a few metres above the estuary bed and is buoyant means that even within its mixing zone it could have no effect on native oysters or native oysters beds.

Strictly speaking the 'Reduce' target can not be met by allowing the discharge because allowing the input of even an insignificant load of metals could not qualify as a reduction. However allowing the discharge will not prevent the achievement of the 'Reduce' target at some time in the future if this is possible. A reduction within the wider MCZ could only be achieved by removing other more significant discharges from the estuary catchment.

(12) Sediment contaminants

Restrict surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.

The processes by which the metals within the water column of the receiving estuary are deposited onto sediments on the estuary bed are too many and complex to calculate what amounts would accumulate within them over time. But it is common sense that, (whatever the processes are) if the existing background concentration of metals in the water column does not change significantly, then the amounts deposited in the sediments could not change significantly either.

As stated in the above section the H1 screening process give us confidence that the existing background concentrations of metals in the receiving Blackwater estuary will not be significantly changed outside a very limited mixing zone as a result of this discharge taking place. On the principle that, if the background concentrations of metals don't significantly change in the water column, the load of sediments accumulating in sediments won't significantly change either, we are therefore confident that allowing the discharge will not threaten a breach of the above target.

Potential 'In combination' affects

On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries.

The only other planned discharges we know of to be taken into account for this assessment are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 30 m3 of treated radioactive site drainage.

The only possible potential for a significant ‘in combination’ affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations.
The fundamental reason we believe the three effluents will not have any significant adverse affects on the above targets and attributes of the MCZ is that this discharge and discharge (b) readily screened out in the initial stages of an ‘H1’ assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. Insignificant’ in the terms of H1 assessments means that there will be no threat of a breach of EQS’s or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three insignificant’ discharges can combine to make a significant difference to the existing background water quality regime in the receiving Blackwater estuary or the other water bodies of the MCZ beyond it.
It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could theoretically be discharged every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary.
Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to threaten any of the targets or attributes that safeguard the CO’s of the MCZ.

CONCLUSION

Our aim has been to assess whether this existing discharge alone or ‘in combination’ made from a new outlet has the potential to adversely impact upon any designated feature of the MCZ or their supporting habitats in their current location, or whether they would prevent the spread or colonisation of them to new areas. We have done this by considering what the zone of potential adverse affect the polluting load from the discharge creates within the receiving estuary.
In this case this zone is extremely limited to a small area around the discharge point. We can not define its dimensions but the H1 screening exercise establishes that it is ‘acceptable’.
We are therefore confident that if we allowed the discharge to be made from the new outlet there would be no significant adverse impact on any of the designated features anywhere within the MCZ.

On this basis the Agency is minded to:

Issue the permission with conditions to ensure no significant adverse affect on the designated features of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

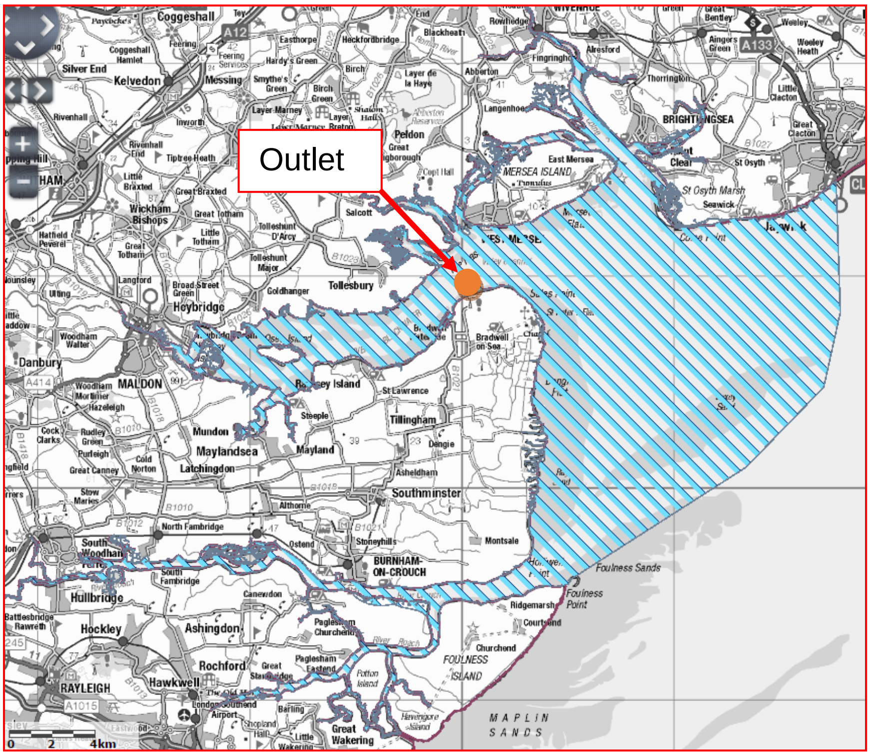
Because all metals in the discharge screen out as being ‘insignificant’ using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to take some occasional routine audit sample and report the concentrations of metals. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis

(26) (Blackwater,Colne, Crouch and Roach Estuaries MCZ – Non Radioactive site drainage.

Habitats Assessment for an application to vary an EPR 'water discharge activity' permit PR2TS/E10760C
Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone
(Based on the N.E. documents Conservation advice for Marine Conservation Zone: Blackwater, Crouch, Roach and Colne Estuaries (BS 03) and a draft copy of the 'Supplementary advice on conserving and restoring site features' for this MCZ)
Name of EA Permitting Officer Bill Greenwood, National Permitting Service, Nottingham Permitting Centre
Date for Environment Agency permit determination 31/3/2016
Predicted 28 day date for NE response 28/3/2016
Date of submission of assessment 29/2/2016
Operator - Magnox Ltd, former nuclear power station site, Bradwell on Sea, Essex.
Discharge – Maximum Daily Volume 30 m3 of treated Radioactive Site Drainage
NGR - TL 99650 09150
Format of this assessment report
A condensed specification of the Conservation Objectives (CO's) is given below followed by a brief background to the proposed discharge and details of its volume and contents. . Below this is an explanation of how we have assessed the potential for the polluting elements of the discharge to hinder, or not, the conservation objectives of the site. Finally there is a conclusion section explaining our 'minded to' permitting position.
Designation Area - The MCZ is located on the Essex Coast extending from the mean high water mark to where the four estuary mouths join the North Sea



Component SSSI sites – Colne Estuary SSSI, Blackwater Estuary SSSI, Dengie SSSI, Foulness SSSI, Crouch and Roach Estuaries SSSI, The Cliff, Burnham On Sea SSSI, Clacton Cliffs and Foreshore SSSI

Overlapping MCZ's – Essex Estuaries MCZ

Overlapping SPA/Ramsar sites – Colne Estuary(Mid-Essex Coast Phase-2), Blackwater Estuary (Mid-Essex Coast Phase-4), Dengie (Mid-Essex Coast Phase-1) Foulness (Mid-Essex Coast Phase-5), Crouch and Roach Estuaries (Mid-Essex Phase-3)

Designation Features – (i) intertidal mixed sediment (ii) Native oyster beds, (iii) Native oysters (Ostrea edulis)

(iv) Clifton Cliffs and Foreshore – ***Note*** – *Because this feature is purely geological the only affects the discharge could have on it would be physical damage if it changed the flow regime in the vicinity. But the discharge is too small (30 m3) and too far (16 km) from the feature to have any physical affect upon it. This feature is therefore excluded from the any further assessment.*

Location of the designated features

Native Oysters are known to occur throughout the four component rivers with distributions of wild populations predominantly clustered around the sublitoral parts of the outer Blackwater and Colne estuaries the Ray Sound Channel and the outer Crouch estuary.

Native Oyster beds

Established beds have been recorded in the the sublitoral parts of the Ray Sand Channel and the outer Blackwater area near Mersea Island.

Intertidal Mixed Sediment has been identified in the Blackwater to the east of Osea Island and the upper reaches of the Blackwater. It was also identified on the north bank of the Crouch upstream of Burnham.

Conservation Objectives for each of the designated features

(3) The features are maintained in favourable condition if they are already in favourable condition

(4) Be brought into favourable condition if they are not already in favourable condition

Definition of favourable condition

For each protected broad-scale habitat:

(7) The extent is stable or increasing and

(8) Its structure and functions its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate.

Any temporary deterioration in condition to be disregarded if the habitat is sufficiently resilient to enable recovery

For each species of marine fauna:

That the population within a zone is supported in numbers which enable it to thrive by maintaining :

(7) The quality and quantity of its habitat and

(8) The number, age and sex ratio of its population

Any temporary reduction in numbers of a species is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery

Relevant Attributes and Targets

The relevant ecological characteristics (**attributes**) of the designated species and habitats and the appropriate water quality conditions (**targets**) that are necessary to safeguard them to meet the Conservation Objectives (CO's) for the MCZ are listed in groups below By 'relevant' we mean that these are the attributes that could potentially be threatened by the contents of the proposed discharge. An example of non-relevant target for this discharge is, "Reduce the introduction and spread of non native species and pathogens and their impacts". This isn't relevant because the permit is to allow a discharge of trade effluent not to allow some form of shell fishery operation. Another example is, " Maintain the total organic carbon (TOC) content in the sediment at existing levels." This isn't relevant because the discharge does not contain any TOC.

Listing the appropriate targets to safeguard the CO's of the MCZ's and grouping them into common types helps to condense this report, avoid too much repetition and focus on the essential issues.

The common attributes (supporting processes and structures) and targets for Native Oysters, Native Oyster Beds and Intertidal mixed sediments are:

(6) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity.

(7) Hydrodynamic and physical conditions

Maintain the hydrodynamic and physical conditions

(8) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels

(9) Sediment contaminants

Restrict surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.

Background to the application
The applicants, wish to vary their existing permit PR2TS/E10760C which is for a discharge of up to 504,900 cubic metres (m3) a day of mixed effluents from the former Bradwell Nuclear Power Station to the Blackwater Estuary. The permitted effluent has always been a mixture of various component effluents discharged in a carrier flow of abstracted seawater to facilitate a positive flow out of a large outlet pipe onto the estuary bed. The existing version of the permit is a variation issued on the 29th of November 2013. It lists the components as secondary treated sewage effluent, trade effluent deriving from water treatment, effluent from the radioactive treatment plant, non-radioactive aqueous effluent and circulating sea-water for flushing.
The most significant components with regard to their potential to cause pollution are the effluents from the radioactive treatment plant and the non-radioactive aqueous effluent. Both these are forms of treated site drainage. The radioactive treatment plant treats void waters and surface water runoff from areas of the site that formerly housed the nuclear plant whereas the other treatment plant treats site drainage from the non-radioactive areas. Both these effluents contain residual traces of several heavy metals. The radioactive treatment plant effluent also contains residual traces of radio nuclides but these are controlled by a separate permit (EPR/ZP3493SQ) and not addressed here.
In recent years the existing large outlet pipe has been silting up and Magnox have constructed a new outlet structure at the same location to use in the event of this becoming completely blocked. There is an ongoing need to drain the site to avoid flooding. The new structure is an array of four much smaller pipes. Actively pumping the effluents out of these will eliminate the need for using large volumes of seawater for flushing but it will change the dispersion characteristics of the effluents within the estuary. For practical reasons using the new outlets will also involve the separation of the radioactive treatment plant effluent from the others so the discharge arrangements will be different in that respect also.
The requested changes to the permit are therefore:-

- to use the new outlet structure
- to discharge much reduced volumes of effluents by active pumping instead of utilising the head pressure of the carrier flow.
- to have two discharges instead of one completely mixed effluent.

The two discharges will be:-

- A mixture of (I) treated non-radioactive site drainage and void waters (ii) secondary treated sewage effluent (iii) trade effluent from water treatment and (iv) clean uncontaminated site drainage
- Treated radioactive site drainage

This consultation concerns the discharge of the treated radioactive site drainage but does not address the radio nuclides within it as these are licenced under a different permit, EPR/ZP3493SQ. The mixed effluent including non radioactive site drainage discharge will be addressed separately in another document for the sake of clarity.
Volume, rate, contents and discharge arrangement
The source of the contaminated site drainage is rainfall runoff and void waters from areas on site where the nuclear plant used to be housed. There is some demolition debris including crushed concrete and waste metals in this area. When rainfall mixes with the crushed concrete it can become strongly alkaline up to pH12. Metals can dissolve in these alkaline waters and the resulting runoff and void waters are therefore high in pH and contain suspended solids and residual traces of metals. This contaminated drainage is collected and treated in an ‘aqueous abatement plant’. The plant utilises pH adjustment membrane filtration, absorption with granular active

carbon and ion exchange processes to neutralise the pH and reduce the pollutants to levels fit for discharge. Table 1 below outlines the metals that are likely to be in the discharge together with their maximum concentrations and a comparison with relevant EQS's.

The maximum daily volume of the discharge is limited by the treatment capacity of the abatement plant which is 30m3. Currently this is discharged as part of the mixture of effluents that drain to a large containment tank before being carried out into the estuary along the large old outlet pipe by up to 505,900 m3 of sea water abstracted for the purpose. In future because the old pipe may become blocked Magnox wish to discharge this effluent out of a new outlet structure designed to achieve the best possible mixing and dispersion characteristics. The new outlet is a 180 mm diameter pipe with a 65 mm nozzle situated 5.5 metres above the estuary bed at right angles to the main current. The discharge would be made on an ebb tide 1 to 2.5 hours after high water pumped at 8 litres per second over one hour. Only one discharge would be made on any one day and the frequency would be dependent on rainfall. In effect the discharge would still be intermittent. The major difference to the existing situation would be the lack of pre-dilution in the carrier flow of abstracted seawater.

Table 1 - Metals concentrations in the treated radioactive site drainage effluent
(Extracts from Table 3 pg 3 of Aqueous Effluent Sample Analysis BRAD/EN/REP133 and Table 6 pg 8 of Env Risk Assessment in support of Aqueous Effluent BRAD/EN/REP/108)

Substance	EQS AA (ug/l)	EQS MAC (ug/l)	Maximum Concentration in Effluent from supporting docs (ug/l)
Cadmium	0.2	N/A	2
Chromium	0.6	32	23
Copper	3.76	N/A	30
Iron	1000	N/A	485
Lead	1.3	14	5
Mercury	N/A	0.07	2.1
Nickel	8.6	34	14
Zinc	7.9	N/A	122

Key aim and principles of the assessment

The key aim of our assessment has been to determine whether the proposed discharge would cause any direct harm to any of the designated features within the MCZ or whether it would prevent them being in 'favourable condition' as defined above. We have therefore tried to asses whether the proposed discharge would prevent the features spreading and colonising new areas as well as whether it would harm them in their current locations.

The only polluting elements of the discharge that are in sufficient strength in the effluent to potentially cause harm within the MCZ are several heavy metals it contains but we have considered its pH also for the sake of completeness.

The criteria we have used for determining ''polluting strength' and the potential for causing harm are the relevant environmental quality standards (EQS's), WFD targets and existing background water quality in the receiving waters. The evidence for the predicted pathways the discharge will take within the receiving waters, and the dilutions it will be subject to, come from the H1 screening exercises and the dispersion modelling undertaken by the applicant's consultants HR Wallingford. These have been vetted by members of our Estuarine Coastal Monitoring and

Assessment Service (ECMAS) team and after some clarification the main results accepted.
The assessment has been simplified in this case by the fact all of the metals in the discharge screen out in as being ‘insignificant’ following H1 criteria and the modelling information supplied by HR Wallingford confirms that all relevant EQS targets are met outside the initial mixing zone.

- Environmental Quality Standards (EQS's)

EQS's are based on research into the toxicity of substances to aquatic flora and fauna. Annual average (AA) EQS concentrations for each substance are fixed at preventing long term chronic effects and maximum allowable concentrations (MAC) concentrations are set to prevent short term acute toxic effects. Both are calculated by applying a safety factor of at least 10 (but sometimes up to a 1,000 or more) to the lowest known toxicity concentration of each substance to any organism, to make sure that marginal breaches do not cause any harm. Not all substances have EQS's of both types.

We can be confident that if the relevant EQS concentrations of a specific substance are met in the estuary waters (after the discharge has mixed within an acceptable mixing zone) no harm would be caused to any aquatic organisms or their habitat. The EQS's we have used in the assessment are those relevant to estuarine waters taken from the EC EQS Directive of 2008 with additions from The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Directions 2010**.**

- Acceptable Mixing Zones and the H1 screening tool

Allowable mixing zones are a concept used in environmental regulation in recognition of the fact that it is not always possible for effluents to be treated to the levels where (EQS's) can be achieved within the discharge. EQS's are in any case meant to apply within the receiving waters not within discharges. Hence mixing zones (within which dilution can reduce contaminants to below EQS's before they spread any further) are allowed. But there are criteria for judging what size of zone is acceptable for each pollutant so that any potential harm can be minimised.
The Agency's published guidance document ‘ *H1, Annexe D1, Assessment of hazardous pollutants within surface water discharges'*, incorporates the concept of mixing zones and EQS's and outlines the stages of a process for determining whether the concentrations of pollutants such as heavy metals within a discharge will have any significant adverse affect on aquatic organisms or threaten any WFD targets. Put simply there are successive screening phases and if the concentrations of each substance do not screen out as being ‘insignificant’ it indicates that more complex modelling is required. The first stage recognises the fact that if the concentrations of substances in the discharge are below EQS levels they cannot have any adverse effect and a further stage incorporates EQS's and a minimum mixing zone approach based on European level guidance on mixing zones. In this case the applicant provided an HI screening assessment and although we had to correct some aspects of it we verified that the conclusions were still valid.

- Modelling in support of the application

Although this effluent passed the initial H1 screening tests Magnox have provided information from a more complex dilution and dispersion modelling exercise which predicts what dilution it will receive within 100 metres of the discharge point. This is because it shares an outlet with another discharge from the site (treated FED effluent) which failed the initial screening tests and had to be modelled. The modelling was undertaken by Magnox's consultants HR Wallingford Ltd and after some clarification members of our Estuarine and Coastal Monitoring and Assessment (ECMAS) team have verified that its results are valid. The modelling predicts dilution factors that will be achieved for this effluent within a mixing zone extending100 metres from the discharge point downstream on the ebbing tide. The key results that apply to this assessment are that the effluent will be diluted by an absolute minimum factor of 240:1 within 100 metres from the discharge point over the hour that the discharge is made in. The minimum 'average' dilution over the same period is 700:1. The minimum 'average' dilution over a 24 hour period is therefore (24 X 700) 16,800:1.

- Pathways and receptors

As stated above the modelling undertaken by HR Wallingford and vetted by members of our ECMAS team established the dilution factors that the effluent will be subject to within an 'initial dilution' mixing zone 100 metres from the discharge point downstream on the ebbing tide. This approach establishes that the maximum zone of influence the pollutants within the discharge could have is limited to this 100 metre plume rising from the outlet 5.5 metres above the estuary bed to the surface. Because the effluent passes the H1 screening tests the EQS's for individual metals would probably be met well within this distance but the modelling does establish the worst case scenario of 100 metres.

Assessment of possible impacts on attributes and targets

Incorporating the principles and information given above our assessment of the potential for the discharge to impact on the relevant attributes and targets (listed above) which safeguard the CO's of the MCZ are addressed below in turn

(13) Physio-chemical properties

Maintain the natural physio chemical properties of the water - Temperature, pH and salinity
The effluent will be discharge at ambient temperatures and will be non-saline. It is too small a volume to influence the existing salinity regime even with the mixing zone. The site drainage is alkaline however and the first treatment process it is subject to is pH adjustment so that the effluent will be in the standard pH range of 6-9 that the Agency routinely imposes on water discharge activity permits. There is no WFD target for pH in marine waters to judge polluting potential but there is an EC directive target for pH in marine waters of 7 to 9 for shellfish for human consumption. This does not strictly apply to conservation areas but is worth some consideration. As stated above the modelling in support of the application indicates that there is an absolute minimum of 240:1 dilution available for this discharge within 100 metres. This is more than enough to buffer any discharge at pH 6 to pH 7. Because the effluent is buoyant it will rise to the surface, so there is no danger of any affect on any receptor beyond the 100 metre mixing zone and none on any receptor on the estuary bed even within it.
The physio-chemical properties of the receiving Blackwater estuary would therefore not be changed outside the initial dilution mixing zone and even within this zone the affects would be limited to slight changes of pH within the effluent plume around the discharge point. There is therefore no threat from pH characteristics of the discharge to native oysters or native oyster beds even within the mixing zone and definitely none outside it.

(14) Hydrodynamic and physical conditions

Maintain the hydrodynamic and physical conditions
The maximum daily volume of the discharge is too small (30 m3) in relation to the flows in the receiving estuary (average volume 106,300,000 m3) to have any affect on the existing background hydrodynamic and physical conditions within it.
We are therefore confident that the proposed discharge from the new outlet would not cause harm to any receptor in any part of the MCZ, or prevent the spread or colonisation of a designated feature into new areas, by changing the hydrodynamic and physical conditions within it.

(15) Water quality contaminants

Reduce aqueous contaminants to levels equating to Good Ecological Status according to WFD. Specifically mercury and its compounds and avoiding deterioration from existing levels. This target relates to samples taken from sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.
The residual concentrations of metals in the discharge (as outlined in Table 1 above) are the only potential threat to the interest features of the MCZ from toxic effects by the effluent. It can be seen from this table that, apart from Iron, all the metals that the discharge contains exceed one of their EQS values. These substances therefore failed the first screening test of H1 and the applicant accordingly applied the second major test.
This test in Annexe D of H1 uses a formula to calculate if the mixing zone for a particular substances is ‘allowable’. It uses the discharge rates and concentration of the substance as well as the appropriate EQS’s and the existing background concentration of the substance in the waterbody in question. Using this formula all the remaining metals in the table above screened out as being insignificant and not liable to cause pollution in the receiving estuary. We had to correct some of the EQS’s used in the applicant’s assessment and some other details but we have verified the results. Because the discharge rate for the new outlet structure was used in the calculation it is valid for the change to the new outlet.
In this case the dilution factors predicted by the modelling give further confidence that the metals in the discharge do not pose any threat. A minimum dilution of 250:1 to be applied to MAC EQS’s and 16,800:1 for AA EQS’s is more than sufficient to prevent any breach of EQS’s outside the mixing zone.
We can therefore be confident that the proposed discharge from the new outlet would not cause any harm to any receptor outside the initial 100 metre mixing zone.
Because the metals in the effluent passed the H1 screening test it is probable that the relevant EQS for each is met well within 100 metres but the modelling demonstrates that 100 metres is the worst case scenario. Because the effluent is buoyant it will not come into contact within any receptors or features on the estuary bed even within the mixing zone so native oysters, or native oysters beds, are very unlikely to be affected by any increases in the background concentrations the effluent cause within the water column even within the mixing zone.
Strictly speaking the ‘Reduce’ target can not be met by allowing the discharge because allowing the input of even an insignificant load of metals could not qualify as a reduction. However allowing the discharge will not prevent the achievement of the ‘Reduce’ target at some time in the future if this is possible. A reduction within the wider MCZ could only be achieved by removing other more significant discharges from the estuary catchment.

(16) Sediment contaminants

Restrict surface sediment contaminant levels to concentrations that are not adversely impacting on the infauna of the feature. This target relates to samples taken from *sediments in an EA sub-tidal grab survey of 2014 in which mercury was above the effective range low (ERL) levels.*

The processes by which the metals within the water column of the receiving estuary are deposited onto sediments on the estuary bed are too many and complex to calculate what amounts would accumulate within them over time. But it is common sense that, (whatever the processes are) if the existing background concentration of metals in the water column does not change significantly, then the amounts deposited in the sediments could not change significantly either.

As stated in the above section the H! Screening process and the modelling reports the applicant provided give us confidence that the existing background concentrations of metals in the receiving Blackwater estuary will not be significantly changed outside the 100 metre mixing zone as a result of this discharge taking place. On the principle that,if the background concentrations of metals don't significantly change in the water column, the load of sediments accumulating in sediments won't significantly change either, we don't think the discharge would have any significant adverse affects on any receptors within the MCZ outside the mixing zone. The potential for a significant affect even within the mixing zone is limited because the discharge will always be made around the high water time on an ebbing tide. It will therefore always be diluted and dispersed extremely quickly and the likelihood of any of the metals within it being deposited onto the sediments on the estuary bed is small.

We are therefore confident that allowing the discharge will not threaten a breach of the above target.

Potential 'In combination' affects

On the 21st of October we wrote to all the other authorities responsible for assessing and licensing plans, projects and operations in the catchment of the Blackwater and wider Essex Estuaries to ascertain if there are any that need to be taken into account in combination with the applications from Magnox Ltd. We have not received any feedback at all to these enquiries.

The only other planned discharges we know of to be taken into account for this assessment are those in the other Magnox applications for the Bradwell site which we are consulting you on. They are (a) the discharge of up to 20 m3 of treated FED effluent and (b) a discharge of up to 130 m3 (in dry weather) of a mixture of, (i) clean surface water runoff, (ii) treated (non-radioactive) contaminated void and surface waters, (iii) secondary treated sewage effluent and (iv) waste water from the treatment of tap water with reverse osmosis filtration.

The only possible potential for a significant 'in combination' affect from the three Magnox effluents on the European site is from the heavy metals that each contain. A few heavy metals are the only pollutants that the three effluents have in common that are present in significant concentrations.

The fundamental reason we believe the three effluents will not have any significant adverse affects on the above targets and attributes of the MCZ is that this discharge and discharge (b) readily screened out in the initial stages of an 'H1' assessment as insignificant, and that discharge (a) has been established by more complex modelling to be insignificant also. Insignificant' in the terms of H1 assessments means that there will be no threat of a breach of EQS's or WFD water quality targets and no significant changes to the existing background water quality outside the mixing zone. In other words we do not believe that three insignificant' discharges can combine to make a significant difference to the existing background water quality regime in the receiving Blackwater estuary or the other water bodies of the MCZ beyond it.

It should also be noted that the physical possibilities for the three discharges to combine in the estuary waters are limited because they are not continuous daily discharges. Two of them are rainfall related and although the FED effluent could

theoretically be discharged every day it is unlikely to happen in practice, which is why an extension to the time limit has been necessary.
Given both the above factors we do not believe that the changes to the three discharges Magnox have applied for (including the change of outlet and the extension or removal of the time limit for the FED effluent) could combine to threaten any of the targets or attributes that safeguard the CO's of the MCZ.

CONCLUSION

Our aim has been to assess whether this existing discharge from the new outlet has the potential to adversely affect any designated feature of the MCZ or their supporting habitats in their current location, or whether they would prevent the spread or colonisation of them to new areas. We have done this by considering what the zone of potential adverse affect the polluting load from the discharge creates within the receiving estuary.
In this case this zone is extremely limited. At worst it is within a buoyant plume of effluent extending up to 100 metres from the discharge point downstream on the ebbing tide. The only designated features which could be affected within the entire MCZ are any oysters or oyster beds within this area. As sated above it is unlikely that even within the 100 metres these features on the estuary bed would be affected. There is definitely no potential for the effluent to have any affect on any receptor in the wider Blackwater estuary the Colne or Crouch and Roach estuaries or the those in the Dengie or Foulness SSSI's because as the effluent spreads out from the mixing zone it will be diluted even further.

On this basis the Agency is minded to:

Issue the permission with conditions to ensure no significant adverse affect on the designated features of the Blackwater, Crouch, Roach and Colne Estuaries Marine Conservation Zone

Issue the variation permission with new conditions that reflect the new circumstances for the use of the new outlet and the separation from the other effluents.

Permit Conditions

The permit will have conditions limiting the maximum daily volume and rate of the discharge and incorporate the specification of the discharge structure and timings to make sure that their benefits are achieved

Because all metals in the discharge screen out as being 'insignificant' using the H1 assessment tools we do not think it is necessary to have a numeric limit for them in the permit. The only numeric limit will be pH 6-9 which is the Agency's standard for all discharges. There will be a 'no visible oil' descriptive condition to guard against any contamination from possible oil spills on the site. This is standard for a site drainage discharge.

The permit will also have conditions requiring the operator to take occasional audit samples of the effluent and report the metals concentrations to us. We have not decided the specifics of the frequency for self monitoring yet but it will be proportionate to the risks the discharge poses. There will also be a requirement to record the date of discharges and the volumes pumped.

Your agreement to granting the variation is sought on this basis

ADDENDUM DOCUMENT

This document was submitted to Natural England to correct clerical errors they had found in the above consultation documents and to respond to the technical queries they had raised during the consultation process. Parts of it also refer to the other the other application we have been determining simultaneously.

Addendum to Habitats consultation documents for applications EPR/DP3127XB and PR2TSE10760 submitted on 29/2/2016

The consultation documents listed below were submitted on the 29 February 2016. This document is an addendum to summarise the changes we have made in the light of your responses and provides extra information to address the concerns you have raised.

Section 1 below outlines what could be termed the clerical corrections and section 2 is a summary of the technical issues.

EPR/DP3127XB (13 documents in total)

This permit is for the discharge of treated FED effluent.

Appendix 4's for, Blackwater Estuary SSSI, Colne Estuary, SSSI, Dengie SSSI, Foulness SSSI, Crouch and Roach Estuaries SSSI

Appendix 11's for, Colne Estuary (Mid-Essex Coast Phase-2) SPA/Ramsar, Blackwater Estuary (Mid-Essex Coast Phase-4) SPA Ramsar, Dengie (Mid-Essex Coast Phase-1) SPA Ramsar, Foulness (Mid-Essex Coast Phase-5) SPA Ramsar, Crouch and Roach Estuaries (Mid-Essex Phase-3) SPA Ramsar, Thames Estuary SPA

Assessments for Blackwater, Colne, Crouch and Roach Estuaries Marine Conservation Zone and for Essex Estuaries SAC

(Note; Essex Estuaries SAC incorrectly treated as an MCZ)

PR2TSE10760 (26 documents in total)

This permit is for two discharges, one of mixed effluent containing treated non radioactive site (Non RAD SD) drainage and one of treated radioactive site drainage (RAD SD). For the sake of clarity we submitted separate consultation documents for each of the habitat sites below for each discharge.

Two Appendix 4's for, Blackwater Estuary SSSI, Colne Estuary, SSSI, Dengie SSSI, Foulness SSSI, Crouch and Roach Estuaries SSSI

Two Appendix 11's for, Colne Estuary (Mid-Essex Coast Phase-2) SPA/Ramsar, Blackwater Estuary (Mid-Essex Coast Phase-4) SPA Ramsar, Dengie (Mid-Essex Coast Phase-1) SPA Ramsar, Foulness (Mid-Essex Coast Phase-5) SPA Ramsar, Crouch and Roach Estuaries (Mid-Essex Phase-3) SPA Ramsar, Thames Estuary SPA

Two assessments for Blackwater, Colne, Crouch and Roach Estuaries Marine Conservation Zone

Two assessments for Essex Estuaries SAC - Essex Estuaries SAC incorrectly treated as an MCZ

(1) Clerical Corrections

Essex Estuaries SAC Appendix 11's

We re-submitted three Appendix11's for the SAC having mistakenly initially submitted them as MCZ assessments. Following your comments on them we now submit them again with your suggested amendments as follows;

(i) Inclusion of the overlapping SPA's/Ramsars
(ii) Conservation objectives amended as suggested
(iii) Inclusion of the information that the only designated feature within the mixing zone is 'subtidal mud' and the extent of the area of this feature in the SAC (as you report) is given for comparison

All other Appendix 11 's

Inclusion of > 20,000 waterfowl assemblage feature for the SPAs and addition of the saltmarsh Ramsar feature in the format agreed in your email of 13 May 2016.

<u>All Appendix 4's</u>

Inclusion of the appropriate interest features to all the Appendix 4's

<u>All consultation documents</u>

In checking the documents for your responses we noticed that the explanation of safety factors for EQS' on all the documents was incorrect. This section has been re-worded on every document.

(2) <u>Technical Issues</u>

To avoid having to rewrite, or add to, sections of 39 documents the technical issues you have raised are addressed here with explanations of which discharge they apply to although some of them apply to all the discharges from the Bradwell site.
In addition to addressing your issues there are some others which have arisen since the consultation documents were submitted which we have discussed informally but not yet put into writing. These are also be outlined and explained below.

'In combination' effects
(applies to FED, Non RAD and RAD when the new outlets have to be used)
Your main response to our consultation documents was the need for a more robust 'in combination' assessment. That is, an assessment of the potential for the metals concentrations in the three discharges from the Bradwell site to combine to have an adverse affect on the features of the designated sites. The three discharges are, treated FED effluent (FED), treated non-radioactive site drainage effluent (NON RAD SD) and treated radioactive site drainage(RAD SD).
In the habitats documents we relied on the fact that the concentrations of metals in the NON RAD SD and RAD SD passed the screening tests in H1 guidance and were deemed to be 'insignificant' and that the hydrodynamic modelling for the treated FED effluent discharge established that it was also 'insignificant'. Our conclusion was that three 'insignificant' discharges (two of which are made on different tides and so cannot combine) could not add up to have significant adverse affect.
The main problem in producing a more quantified approach to potential 'in combination' affects was that the applicant did not provide modelling dilution factors for the NON RAD SD because it passed the H1 screening exercise. However in the light of your request we asked our modelling experts to see if they could help with this and they subsequently used the information in the application and some standard modelling software to calculate what is called an 'initial dilution' (ID) factor for the NON RAD SD.
ID's are the dilutions factors that effluents are subject to just within the water column as they rise to the surface. They are conservative because they do not take account of any lateral dilution as the current moves and disperses the effluent to the edge of the mixing zone. In this case our modeller calculated what is termed a 'still water' ID which is even more conservative because it does not even take account of the water current moving through the effluent column as it rises. The ID dilution factor was also calculated using the depth at the lowest astronomical tide because the NON RAD SD effluent is part of the mixed effluents discharge that is pumped automatically and can occur at any tidal state. The resulting ID factor is therefore an extreme worst case scenario that could not actually occur in any real event. However it is useful as tool to rule out any possibility of an instantaneous toxic 'in combination' event.
Our modeller's first calculation of ID was a factor of 4.8:1 and this is the figure we gave you in our original 'in combination' assessment in our email on the 16 May 2016. The email included a table which added up the contributions of metals concentrations from the three effluents on to the existing background concentrations.

Subsequently our modeller needed to revisit the calculation for another purpose and found that a slight error had been made. Having corrected the error the revised ID factor is now calculated to be 9.2:1.

The table below is a revised version of the one we sent you on the 16 May 2016. It is different in two respects. The first is that we have used the 9.2:1 dilution factor to recalculate the contribution of metals from the Non RAD SD. The second is that instead of using the maximum concentration of metals detected in the FED effluent we have used the emission limit for each metal that we are intended to put on the permit we are minded to issue. We didn't do this in the original table because we had not calculated definitive limits at that stage.

With the exception of Iron the emission limits have been derived by doubling the maximum concentrations detected in the effluent in accordance with our guidance for the setting of limits for existing discharges of trade effluent. In the case of Iron we have quadrupled the maximum concentration for reasons outlined separately in a section below.

The table below illustrates how we have used these figures, and the absolute minimum dilution factors for the FED (250:1) and NON RAD (240:1) from the applicants hydrodynamic modelling of the effluents, to calculate what contribution each would make to the overall concentration of each metal in the estuary at the edge of the mixing zone. It shows that if all three discharges made their contribution of metals into the mixing zone at the same time and this was added to the existing background concentrations, there would be no breach of the MAC EQS at the edge of the zone for any substance.

As illustrated in the table the contribution from each discharge has been calculated by dividing the maximum concentration detected in each effluent by the dilution factor that has been calculated for it. For the metals that do not have MAC EQS's I have included the AA EQS in the table to give something to make a comparison with. It can be seen that there is only one case where the AA EQS would be slightly breached. The total contributions and the background concentration of Zinc add up to 10.56 and the AA EQS for Zinc of 7.9. However in practice no AA EQS's would be broken because the dilutions available for AA EQS's are huge (i.e 48,000 :1).

It should also be noted that the total concentration of all the contributions plus the background concentrations in the bottom of each column is a very large overestimate that could not occur in practice. This is not only because the 9.2:1 factor used for the NON RAD SD does not allow for any movement of current through the vertical mixing zone or any lateral movement over 100 metres, but also because the FED and NON RAD contributions could not be at the edge of the mixing zone at the same time. This is because they will be discharged on different tides even if they were discharged on the same day. There will always, therefore, be several hours between them and each one will have cleared from the edge of the mixing zone before the next one takes place. We have only included the three together to completely rule out any chance of an 'in combination; effect.

We haven't produced a similar table for the combination of the effluents compared with annual average EQS's because the dilution factors for AA EQS's are much greater than for MAC's (i.e 48,000 :1 for FED) so the contributions for each effluent can only be very much lower than the one in the table. So the result would be the same it would just be more emphatic.

It is therefore clear that the three discharges can not combine with each other or the existing background levels to create a short term toxic effect, or a long term chronic effect in the receiving waters outside the mixing zone.

Discharge

Type	Cadmium (ug/l)	Chromium (ug/l)	Copper (ug/l)	Iron (ug/l)	Lead (ug/l)	Mercury (ug/l)	Nickel (ug/l)	Zinc (ug/l)
Contribution from the treated **FED** effluent to metal in the mixing zone (Max Conc in effluent divided by minimum dilution of 250 :1)	45.2 ÷ 250 = 0.18	372 ÷ 250 = 1.48	2,478 ÷ 250 = 9.9	3,000 ÷ 250 = 12.0	134 ÷ 250 = 0.53	10.4 ÷ 250 = 0.04	454÷ 250 = 1.8	2,086. ÷ 250 = 8.3
Contribution from the **RAD SD** (Max Conc,in effluent divided by the minimum dilution of 240:1)	2 ÷ 240 = 0.008	23 ÷ 240 = 0.09	30 ÷ 240 = 0.1	485 ÷ 240 = 2.0	5 ÷ 240 = 0.02	2.1 ÷ 240 = 0.008	14 ÷ 240 = 0.05	122 ÷ 240 = 0.50
Contribution of the **NON RAD SD** (Max Conc in effluent divided by the minimum dilution of 4.18 :1)	Nil	11.4 ÷ 9.2 = 1.2	3.23 ÷ 9.2 = 0.35	Nil	1.54 ÷ 9.2 = 0.16	Nil	4.92 ÷ 9.2 = 0.53	5.23 ÷ 9.2 = 0.56
Background Concentration	0.018	0.250	1	57.96	0.024	0.008	0.94	1.2
Total	0.2	3.02	11.35	71.96	0.734	0.056	3.32	10.56
MAC EQS	No MAC EQS (AA EQS 0.2)	32	No MAC (AA EQS 10.9)	No MAC (AA EQS 1000)	14	0.07	34	No MAC (AA EQS 7.9)

Sediment sampling
(applies to FED, Non RAD and RAD when the new outlets are used)
The background to this issue is the concern about metals from the discharge adding to the existing levels of metals in the sediments of the receiving waterbodes. This follows the results of a sub-tidal grab survey by the Agency in 2014 which revealed that several metals in these sediments are above the ‘ Effects Range Low’ threshold which ‘often causes adverse effects in marine organisms’ as reported in your conservation advice document.
Our view on this risk ,as expressed in our consultation documents, is that, if the discharges can not cause a significant increase in the metals concentrations in the

water column outside the mixing zone they could not cause significant increases in the deposition of metals into the sediment.
Whilst accepting this principle you subsequently inquired whether sediment sampling in the estuary by the applicant would give extra confidence of no adverse affect. Your full question and our response is given below.
Your question in an email of the 6 April 2016
Sediment contaminants – Previously I asked whether or not it would be possible to append as a condition to the permit the need to undertake some sediment contaminant sampling. I believe you mentioned that this was not really feasible and I queried whether or not this would be covered by wider WFD monitoring. Am I correct in thinking that for WFD purposes only aqueous sampling is undertaken? If this is the case, do you have information on the general sediment flow within the Blackwater Estuary and could this be used to establish the possible fate of any heavy metals that may settle out? If so, would these areas be overlapped by existing aqueous sampling points or would additional points need to be added to the sampling programme? It would be useful to get a bit more information around this, as both our national specialists shared the concern over possible accumulation of heavy metals. We do acknowledge that the levels of heavy metals are relatively low and that the FED discharge is limited, however owing to existing elevated levels of heavy metals in the wider estuary it would be good to rule out a cumulative impact here and monitoring would enable this to be done.

Our responses
With regard to our sampling, the bottom line is that we have been taking sediment samples and analysing them for metals for many years in various parts of the Blackwater estuary under various legal and environmental drivers. Most recently our contaminant monitoring is driven by the requirements of the EQS and WFD Directives. The EQS Directive defines EQS's for metals in the water column and some in biota (e.g. mercury), with a requirement to monitor trend substances in biota or sediment. There are no EQSs defined for the sediment.
In this case (because the main FED discharge and the Treated Radioactive Site Drainage discharge are both made only on ebbing tides around high water) our most relevant sampling point (which is now the only routine point for sediments) is in the outer Blackwater Estuary at National Grid Reference TM 06400 11500. It is relevant because the two discharges from the site that have the most significant metals traces are only made on the high waters of the ebbing tide and the sample point is downstream for ebb tide purposes. As previously explained we don't believe the Magnox discharges will change the existing background water quality beyond the 100 mixing zone, so we are sure they not have any effect on the inner estuary from returning tides.
From 1999 to 2009 our site in the Outer Blackwater (OBW) was sampled annually, taking five replicate samples on each occasion, for the Clean Seas Environmental Monitoring Programme (CSEMP) for metals as defined by OSPAR requirements. From 2009 the sampling frequency changed to every 3 years and the replicate samples further 'spread out' across the water body. The last samples were taken in April 2015. Alongside the CSEMP sediment monitoring, blue mussels, *Mytilus*, are sampled annually for contaminant analysis at a single site (three replicate samples) in the Outer Blackwater.
The data from these sampling programs are put onto our internal data archive for periodic review for long-term trends but they are also reported to other organisations for various purposes including reporting for OSPAR requirements. These data are available to view freely on the British Oceanographic Data Centre website -
http://www.bodc.ac.uk/projects/uk/merman/assessments_and_data_access/csemp/
The MERMAN data assessment viewer displays trends for metals in sediments and in blue mussels at the OBW site. Please note that the latest data may not yet be

available through this website but our joint NE/EA marine monitoring officer, should be able to directly access these data for you and provide detail on the sampling strategy and data. Periodically our whole sampling strategy is reviewed to make sure it is fit for purpose Currently the sampling for 'metals in sediments' has been paused whilst consideration is given to whether the focus of future sampling should be concentrated on 'biota' alone. Potentially, the biota trend monitoring and assessment is providing a clearer picture of recent exposure.
With regard to the question you asked about our sampling of suspended solids (SS) to get a feel for the pattern of sediment deposition in the estuary, the answer is that we have got records of SS's but we can't measure the complex flow patterns within the estuary, so there is no means of predicting deposition patterns.
To conclude on this aspect of your responses to our consultation documents, I can say that, (I) we do have historical data for metals in the sediments in the outer Blackwater Estuary, (ii) we also have data for metals in biota, (iii) this information is available to you via the liaison officer and the above website, (iv) there will be an ongoing programme of monitoring in the outer Blackwater but it may well be focused on metals in biota rather than in sediments (v) if we restrict sampling to biota it will be because our estuarine and hazardous substance experts believe this is more meaningful and (vi) this data will be capable of showing trends.
With regard to the possibility of requiring the applicant to take sediment samples and have them analysed for metals we have considered this and do not think it is a good idea for the following reasons:-

1. The first obvious one is that we think that our ongoing sampling program is sufficient.

2. If the concentrations of the relevant metals in the sediments did increase during the time the discharge took place it would not be possible to be sure this was the result of the Magnox discharges. The metals could have come (via the water column) from another source anywhere within the catchment, or from the wider coastal waters or the open sea. Or they could have come from a shift in sediments from another part of the estuary which have higher concentrations of metals.

   Trend analysis is needed for assessing whether there is a general problem in the wider catchment that needs addressing but it is not possible, in an estuary, to relate trends at any location to any individual point sources. If a strong increasing trend indicated a threat to the estuary we would do our best to pinpoint all the known sources and we would then have to target any actions at the significant, major contributors of metals. As outlined in our consultation documents we do not believe the treated FED discharge and the other discharges from the site have the potential to be significant contributors.

3. Without any means of knowing what had caused an upward trend in metals in the sediments we would not be able to justify taking any mitigating action against Magnox if such a trend was detected from their sampling.

4. When setting permit conditions we have to be certain that they are logical, meaningful, justifiable and legally enforceable. Given the above we don't think that this would be the case for a sediment sampling requirement.

To conclude overall, we believe that our sampling programme will be sufficient to detect any trends of increased deposition of metals within sediments within the sphere of influence of the discharge and that it is not possible to justify a permit condition for extra monitoring by the applicant.

Temperature affecting mixing of the effluent
(mainly applies to FED when the new outlet is used)

Although it is not explicitly stated in the modelling documents provided in support of the application, the effects of the temperature of the FED effluent on its mixing within the receiving waters has been taken into account, Our modelling expert has verified that this has done correctly and that the results of the modelling exercise are valid.

We note your comments that the pumping of the Non RAD SD and RAD SD could raise the temperature of these effluents very slightly. We agree with your conclusions that these rises will be extremely small and not significant,

Plant response confined to the outer estuary
(applies to the FED only)

We note your comment that it is useful to state that the potential for adverse (eutrophic) plant responses occurring from the nitrate load of the FED discharge would be limited to the outer Blackwater estuary. This is the view of our modelling expert based on her vetting of the applicant's hydrodynamic modelling and further work she undertook herself.

Limiting of discharge timing may be restricted
(applies to FED only when the new outlet is used)

In the consultation documents for the treated FED effluent discharge we stated that additional work undertaken by our modelling expert indicated that there would be an advantage (in terms of further limiting the potential effects of nitrates on plants in the estuary) in having a permit condition that would restrict the discharges of FED effluent to only those tides that ensured that the returning incoming tides happened in darkness, and that we intended to have such a condition in the draft. However when we informed the applicant of this they said that this would be impractical in some periods of summer, because of the long hours of daylight.

We have therefore asked the applicant to produce an 'operating technique' (OT) that will outline the criteria for the timing for discharges to be made as often as is practicable (given the hours of daylight and the timing of the tides) on a tide that will ensure a returning tide is in darkness. We will endeavour to ensure that this OT is as robust as possible.

It should be remembered that the purpose of this discharge timing was mitigation within an acceptable parameter for protection of the environment and not an essential requirement to ensure that water quality targets are met and the environment protected.

Change of the volume of sewage effluent
(applies to the mixed effluent discharge only when the new outlet is used)

As part of the determination process we asked the applicant to verify the specification of their package sewage treatment plant (STP) that serves the workforce on site and the effluent from which forms part of the 'mixed effluent' discharge controlled by permit PR2TSE10760.

In their response the applicants stated that the maximum daily volume the STP could discharge is 45 cubic metres (m3) and not 30 m3 as indicated in the application. This volume is the designed maximum daily capacity of the STP and is suitable for the current size of workforce on site. The daily volume is unlikely to reach this level because the per capita water usage on site is probably lower than the maximums used for the design of STP's but (for the purposes of assessing the impact) we have to assume the worst case scenario of this occurring every day.

For the existing discharge of sewage effluent in large volumes of abstracted seawater the possible increase in volume is definitely not significant because of the big pre-dilution.

However when the new outlet has to be used we still do not believe that the 15 m3 increase will be significant. This is because of the way the mixed effluent discharge is made via automatic pumps from a holding chamber. As described in the main consultation document, as well as receiving STP effluent the holding chamber also takes two types of site drainage and a small volume of reverse osmosis waste waters. A float switch in this chamber is set to discharge 130 m3 from it when a certain level is reached and up to a maximum 50,000 m3 on one day, if ingress continues because of continued wet weather.

This means that in a period of prolonged dry weather the only input into the chamber may be treated sewage effluent and, after a few days , this may trigger a discharge of 130 m3 of treated effluent alone.

Prior to being informed of the potential increase of the daily volume of the STP effluent we had already based our impact assessment on this worse case scenario of a 130 m3 discharge made up entirely of sewage effluent. The only difference the increased volume makes is that the number of days it could take the sewage effluent alone to trigger a discharge will be slightly less.

Because the discharge is pumped automatically it could occur on any tidal state and in any current flow. We have therefore considered the absolute worst case scenario of a discharge of 130 m3 of STP effluent at the lowest tidal state. As stated above the lowest possible dilution for the effluent at the lowest astronomical tide has been calculated by our modelling expert to be 9.2:1 but this only takes account of dilution upwards in the water column and not of dilution that it would receive laterally or as current flows through the mixing zone. However even a 9.2:1 dilution is enough to prevent any instant polluting effects from the effluent which is designed to achieve a standard of 20 mg/l BOD (Biochemical Oxygen Demand) 30 mg/l suspended solids and 20 mg/l of ammonia. Because sewage effluent is buoyant it will rise to the surface to mix further and pose no risk to species on the estuary bed. On other tidal states and when there are site drainage waters mixed with it the dilution factors for the sewage effluent will be much greater. For these reasons we do not believe the increase in the possible maximum daily volume of the treated sewage effluent into the holding chamber from 30 m3 to 45 m3 poses any risk to any of the designated features of any of the habitats sites.

Proposed change to emission limit for Iron

In the consultation documents we stated that we would be setting emission limits for substances on the permit for the treated FED effluent that would, prevent a breach of the conservation objectives of the MCZ and protect all the designated interest features of all habitats sites listed above.

When setting emission standards for hazardous substances (such as metals) the Agency does not allow individual discharges to take up all the environmental tolerance available in the receiving waters but seeks to minimise the release of them as far as possible. But this has to be balanced with what it is practical for the permit holder to comply with and the knowledge that all effluents have the potential to fluctuate in quality. Where there is a lot of tolerance within the environment we are able to allow a little for these possible fluctuations. This prevents us having to become engaged in enforcement work for failures of limits that would not actually have any adverse environmental impact because of there being sufficient dilution in the receiving environment. In this case for instance there is 48,000:1 dilution available to prevent a breach of an AA EQS. Theoretically we could set an emission standard close to 48,000 X the AA EQS for the discharge without causing a breach of the EQS outside the mixing zone. But because we want to minimise the releases of substances we would not set such a limit.

In line with the ‘H1’ guidance (published on the Gov.UK website) we can set emission standards for existing discharges of trade effluent up to twice the maximum concentrations detected in the effluent and higher multiples if it is justified. With the

exception of Iron that is what we are proposing in this case and the table above demonstrates that this would not lead to breaches of EQS.
The reason we have made the exception for Iron and quadrupled the maximum concentration to derive an emission standard are;

(1) Iron is less toxic and persistent in the environment than the other metals detected in the effluent.

(2) In contrast to the other metals detected in the effluent, the maximum iron concentration detected is less than its EQS. The maximum detected is 745 micrograms and the EQS is 1000 micrograms.

(3) Iron is also one of the metals that does not have a MAC EQS so there is no threat of a direct toxic affect from a breach of concentrations well in excess of 1000 micrograms

(4) Iron is not one of the metals detected in concerning concentrations in the grab survey of metals in sediments mentioned in the MCZ conservation advice.

(5) Allowing some extra leeway for iron will prevent the applicant missing some discharge opportunities which would be costly for them and would also delay the completion of the FED project.

    The background to this is that Magnox Ltd analyse every batch of treated FED effluent and check the results before deciding to discharge it. If there is any failure of an emission standard they will not make a discharge. Failing to make a discharge on the high waters of a tide means that many hours can be wasted until the effluent is re-tested for greater accuracy or re-treated to meet the effluent standard. Currently, because they are able to allow for large volumes of pre-dilution in abstracted seawater, the metals standards on the existing permit are routinely met. But when the switch is made to the new outlet and the new emission limits have to be met without pre-dilution there is the potential for marginal failures of a limit to cause delays.

    The analytical data that Magnox provided for past discharges indicates that on quite a few occasions they would not have been able to meet the proposed metals limits and make a discharge (without re-testing or re-treating) if they had not had the facility to pre-dilute their effluent. So in future without pre-dilution there is the risk of this happening. They have therefore requested that we relax the indicative metals limits we have given them to prevent costly delays.

    Except for Iron we have declined to do this because the evidence we have at the moment does not support a relaxation. However in case of iron we are minded to double again our original doubling of the maximum concentrations detected in the effluent and our new proposed emissions standard for iron is 3,000 micrograms. The table above shows that this would not threaten a breach of any EQS. Iron only has an AA EQS and there is 48,000:1 dilution for the treated FED effluent at the edge of the mixing zone.

    Allowing this relaxation of the proposed iron limit will therefore help to prevent a few delays of the operation without risking a significant adverse affect on the environment.

THE RESPONSE FROM NATURAL ENGLAND TO THE ABOVE CONSULSTATION DOCUMENTS

Date: 08 July 2016
Our ref: 180591
Your ref: PR2TS/E10760, EPR/DP3127XB

Bill Greenwood
Water Quality Permitting Officer
Environment Agency

NATURAL ENGLAND

International House, Ashford, Kent TN23 1HU.

T 07788 574908

BY EMAIL ONLY

Dear Bill

Advice on Bradwell Discharge Permits: PR2TS/E10760 (NON-RAD and RAD), EPR/DP3127XB (FED)

Thank you for your request for formal advice on the above discharge permits, received 28 June 2016. The following constitutes Natural England's formal statutory response.

Please note that the advice below relates to the following documents which formed part of this consultation:

1. 15 Appendix 4 documents
2. 21 Appendix 11 documents
3. 3 MCZ Assessments
4. Habitats Addendum Report

Natural England welcomed the dialogue between the Environment Agency and ourselves during the drafting and finalisation of these documents. Throughout these discussions Natural England worked on the principle that the EA is the competent statutory body to assess such impacts and therefore, to a large extent relied upon your status and public duties to ensure that issues relating to water quality were adequately assessed.

We believe that the Habitats Addendum Report provides a useful overview of the key issues we sought clarification on and further, it sets out clearly the appropriate analysis and mitigation which underpins the decisions relating to these three discharge permits.

Marine and Coastal Access Act 2009

The proposed discharges, as set out in the information provided, occur within a Marine Conservation Zone (MCZ).The Blackwater, Crouch, Roach and Colne Estuaries MCZ has been designated due to the presence of:

- Intertidal mixed sediments
- Clacton Cliffs and Foreshore
- Native oyster *(Ostrea edulis)* beds
- Native oyster *(Ostrea edulis)*

Having reviewed the evidence and mitigation relating to the site we believe that the discharges will not hinder the conservation objectives of this site, so long as they are undertaken in strict accordance with the conditions that the EA are minded to append to the permits.

<u>The Conservation of Habitats and Species Regulations 2010 (as amended) and The Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended)</u>

We can confirm that the three discharges are located both within and adjacent to the Crouch and Roach Estuaries Special Protection Area (SPA) and Ramsar, Blackwater Estuary SPA and Ramsar, Colne Estuary SPA and Ramsar, Dengie SPA and Ramsar, Foulness SPA and Ramsar, Outer Thames Estuary pSPA and Essex Estuaries Special Area of Conservation (SAC). Please note that the Outer Thames Estuary pSPA is currently out for consultation regarding an extension to the site to cover the marine foraging areas of two tern species which are features of the exisiting coastal SPAs. We are aware that the original Appendix 11 document drafted for this site was written prior to these proposals and does not include these new features and extents. We can confirm, however, all the information provided in the forms for the coastal SPAs adequately assess any potential impacts to these species (including whilst they are foraging at sea).

Having reviewed the evidence and mitigation relating to these sites, providing the permits for these discharges are granted with the conditions outlined in the documentation appended, it can be excluded that they will have a significant effect on any SPA, SAC or Ramsar site, either individually or in combination with other plans or projects. Therefore it is our view that an Appropriate Assessment of the implications of these discharges on the site's conservation objectives should not be required.

<u>Wildlife and Countryside Act 1981 (as amended)</u>

We can confirm that the proposed discharges are located either within or adjacent to Blackwater Estuaries SSSI, Colne Estuary SSSI, Dengie SSSI and Foulness SSSI. Natural England advises that the permits, if granted with the conditions outlined in the documentation appended, are not likely to damage the interest features for which the sites have been notified.

Please note, if the EA are minded to grant these permits with different conditions from what has been detailed in these assessments, our advice may not remain fit for purpose and we would need to be re-consulted. For any queries relating to the content of this letter please contact me using the details provided below.

Yours sincerely

Ingrid Chudleigh
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