Designation of Land at Cells Zero, One & the Original Fill at Oakley Wood Landfill as Special Sites

Environmental Protection Act 1990 Section 78C(1); Contaminated Land (England) Regulations 2000 Regulations Two, Three and Schedule One

1. This Special Site Designation has been prepared in accordance with paragraph 18 of Annex two and paragraphs seven to 15 of Annex Four of the DETR Circular 02/2000[1] and has been prepared by Darren Detheridge 'the Contaminated Land Officer' of South Oxfordshire District Council 'The Local Authority'.

2. In accordance with the DETR Circular 02/2000 guidance, The Local Authority has designated 'the contaminated land' as described in the 'Determination document[2]' as a Special Site as defined in Regulation three (c) and Schedule one of the Contaminated land (England) Regulations 2000 'the regulations [3]'.

3. Advice has been requested from the Environment Agency that 'the contaminated land' might be required to be a Special Site in accordance with Section 78C(3) of the Environmental Protection Act 1990 'the 1990 Act'.

4. Based on the evidence set out in Schedule two, and the assessment of this evidence in Schedule three of the 'Determination document' and the evidence set out Schedule One, and the assessment of this evidence in Schedule two of this document, it appears to 'The Local Authority' that 'the contaminated land' must be designated a Special Site in accordance with Section 78C(8) of 'the 1990 Act' and paragraph a of Regulation two of 'the regulations' for the reasons set out in Schedule three to this document, namely that:

    i) Substances (Trichloroethene, Tetrachloromethane, Vinyl Chloride, Benzene and Xylene) listed in paragraph One of Schedule One to 'the regulations' as organohalogen compounds, mineral oil and other hydrocarbons and substance which possess carcinogenic properties in or via the aquatic environment) are;
    ii) Polluting waters contained within underground strata that comprise formations of rocks listed in paragraph Two of Schedule One to 'the regulations' (Upper Cretaceous Chalk).

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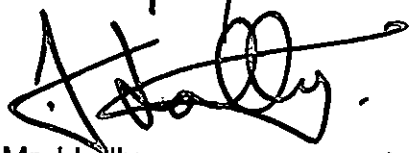
[1] DETR Circular 02/2000 Environmental Protection Act 1990: Part IIA Contaminated Land 20th March 2000
[2] Determination of Land at Cells Zero, One and the Original Fill at Oakley Wood Landfill as Contaminated Land
[3] Contaminated Land (England Regulations) 2000

5. In accordance with Section 78C(2) of 'the '1990 Act[4]' the 'relevant persons' have been consulted on this Special Site Designation. A list is given in Schedule Four.

Dated: 14/06/2006



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[4] Environmental Protection Act 1990 Part IIA

Abstract

Following from the determination of land at Cells Zero, One and the Original Fill at Oakley Wood Landfill as contaminated land, South Oxfordshire District Council 'The Local Authority' considers that the Cells should also be designated as a Special Site.

The Local Authority has acted in accordance with the DETR Circular 02/2000, guidance and has consulted the Environment Agency for their view on the Special Site designation.

Based on the evidence, it appears to 'The Local Authority' that 'the contaminated land' At Oakley Wood Landfill must be designated a Special Site in accordance with Section 78C(8) of 'the 1990 Act' and paragraph a of Regulation Two of 'the regulations' for the following reasons:

i) Substances (Trichloroethene, Tetrachloromethane, Vinyl Chloride, Benzene and Xylene) listed in paragraph One of Schedule One to 'the regulations' as organohalogen compounds, mineral oil and other hydrocarbons and substance which possess carcinogenic properties in or via the aquatic environment) are;

ii) Polluting waters contained within underground strata that comprise formations of rocks listed in paragraph Two of Schedule One to 'the regulations' (Upper Cretaceous Chalk).

In accordance with Section 78C(2) of 'the 1990 Act', The Local Authority has notified the Environment Agency, Oxfordshire County Council as Appropriate A Person and all occupiers and owners of the contaminated land at Cells Zero, One and the Original Fill at Oakley Wood Landfill of this Special Site designation.

Introduction

Following from the determination of land at Cells Zero, One and the Original Fill at Oakley Wood Landfill as contaminated land, South Oxfordshire District Council 'The Local Authority' considers that the Cells should also be designated as a Special Site.

The Local Authority has acted in accordance with the DETR Circular 02/2000 guidance and has consulted the Environment Agency for their view on the Special Site designation.

This Special Site designation will not replicate the information and assessments made in 'The Determination Document' and may need to be referred to for further information. Please contact the Environmental Health Team on 01491 823214 to obtain a copy of this document.

Schedule One: Summary of evidence upon which the special site designation is based

This Schedule will summarise the evidence that has been used to designate Cells Zero, One and the Original Fill of Oakley Wood Landfill as a Special Site. Further information on the contaminants identified at Oakley Wood Landfill is available in 'The Determination Document'. This Schedule will focus only on the contaminants that were identified as being part of the significant pollutant linkage relating to pollution of controlled waters in the 'Determination Document' and that are listed in 'the regulations' as contaminants that would mean the site is defined as a Special Site (listed contaminants).

The following table One contains all the 'listed contaminants' that are polluting the Chalk Aquifer from each of the landfill Cells Zero, One and the Original Fill at Oakley Wood Landfill. It provides the evidence that has been used to designate these Cells as a Special Site.

Table One: Maximum Concentrations of Listed Contaminants Identified in Soils and Leachate at Cells Zero, One, the Original Fill and the ground water at Oakley Wood Landfill (ug/kg; ppb) (AEAT; June 2000)

Contaminant/ Sample Location	Cell Zero		Cell One		Original Fill		Ground water	Assessment Criteria
	Leach Test	Leachate	Leach Test	Leachate	Leach Test	Leachate		
Trichloroethene (TCE)	MW4 757	<1	MW9A 3613	<1	MW1A 32	<1*	30ug/l Combined+	10ug/l Combined UK DWS
Tetrachloroethene (PCE)	MW4 24	<1	MW9A 3371	<1	MW1A 250	<1*		
Vinyl Chloride/ MW9A	<1	<1	MW9A 308	<1	<1	<1	7ug/l	0.5ug/l (UKDWS)
Benzene	MW4 32	MW6 8	MW8 67	MW1 8 13	MW3 20	MW3 9	3ug/l	1ug/l (UKDWS)
Xylene	MW6 19725	MW6 108	MW8 4682	MW1 8 119	MW1A 1084	MW3* 210	64ug/l	30ug/l (UK EQS)

* no free leachate analysis was undertaken for the samples taken from MW1A. Leach tests at this location had predicted elevated levels of TCE and PCE would migrate from the landfill waste.
+ June/ August 2004 groundwater monitoring by Serco Assurrance Ltd

From the above table it can be seen that the concentrations of listed contaminants, specifically chlorinated solvents (Tetrachloroethene (PCE), Trichloroethene (TCE) and Vinyl Chloride) and BTEX contaminants (Benzene and Xylene) are predicted to leach out of waste materials in Cell Zero, Cell One and the Original Cell at concentrations that would exceed their respective groundwater assessment criteria (Drinking Water Standards or Environmental Quality Standards).

Chlorinated solvents were not identified in the leachate at concentrations that exceed their assessment criteria in any Cell at Oakley Wood Landfill, although BTEX contaminants were identified in the leachate of Cell Zero, Cell One and the Original Fill at concentrations exceeding their assessment criteria. Groundwater contamination of all chlorinated solvents and BTEX contaminants identified at Cells Zero, One and the Original Fill has occurred at concentrations exceeding the assessment criteria.

Schedule Two: Summary of the relevant assessment of the evidence upon which this special site designation has been made

An assessment of the evidence provided in Schedule Two has been undertaken by 'The Local Authority' and the Environment Agency (EA) in this Schedule.

The EA report in a letter dated 22 June 2005 that the leachate samples demonstrate there is a contamination source at Oakley Wood Landfill. The risk assessment work undertaken by AEA/ Serco on ammonium contamination demonstrates that there is a pathway for the contamination and that there are private water abstraction and Chalk Aquifer receptors present.

Also that groundwater contamination monitoring around the site has identified drinking water standards being exceeded for benzene, TCE and PCE.

The EA conclude in their letter of the 22 June 2005 that there is a source, pathway and receptor and that the receptor is being impacted by list 1 substances (BTEX and chlorinated solvent contaminants). A copy of this correspondence is in the Appendix of 'The Determination Document'.

The Local Authority, having reviewed of the monitoring data in the above Schedule One agree with EA's interpretation of the information. The Local Authority also consider that the list 1 contaminants (Xylene and Vinyl Chloride) also form significant pollutant linkages due to the leach tests and groundwater monitoring data illustrated in Table One.

In conclusion, The Local Authority is of the opinion that the following significant pollutant linkage exists that meet 'the regulations' definition of a Special Site:

- Pollution of waters contained within the Upper Cretaceous Chalk underground strata is occurring from the migration of organohalogen compounds, mineral oil and other hydrocarbons and substances which possess carcinogenic properties in or via the aquatic environment (BTEX and Chlorinated Solvents) from Cells One, Zero and the Original Fill at Oakley Wood Landfill

Schedule Three: The requirements of the regulations/ legislation for designation of a Special Site

The Local Authority has followed the guidance set out in paragraph 18 of Annex two and paragraphs seven to 15 of Annex Four of the DETR Circular 02/2000. The Environment Agency has been consulted for advice in accordance with Section 78C(3) of 'the 1990 Act'.

It appears to 'The Local Authority' that 'the contaminated land' meets the requirements of a Special Site in paragraph a, of Regulation Two and Regulation 3c of 'the regulations' and is therefore required to be designated as such a site in accordance with paragraph a, of Regulation Two. More specifically that the requirements of the above section of the regulations have been met as substances listed in paragraph one of Schedule one to 'the regulations' are polluting a formation of rocks containing water listed in paragraph two of Schedule one to 'the regulations'.

Schedule Four: Persons Notified of Special Site Designation in Accordance with Section 78C(2) of 'the 1990 Act'

Environment Agency
ISIS House
Howbery Park
Wallingford
Oxon
OX10 8BD
In capacity as a regulatory body

Chief Executive
Oxford County Council
Speedwell House
Speedwell Street
Oxon
OX1 1NE
In capacity as the appropriate person

S Grundon (Ewelme) Limited of Estates Office
Grange Lane
Beenham
Berks
RG7 5PT
In capacity as proprietor of Fill Cell Zero

Noel Henry Frost
Polruan
Oakley Wood
Benson
Oxon
In capacity as proprietor of Fill Cell Zero

Noel Henry Frost
18 Hambleden Drive
Wallingford
Oxon
In capacity as proprietor of Fill Cell Zero

Jean Marion Fenn
Oaklands
Old Icknield Way
Benson
Oxon
In capacity as proprietor of the Original Fill

Patrick Michael Fenn
Oaklands
Old Icknield Way
Benson
Wallingford
Oxfordshire
OX10 6PW
In capacity as proprietor of the Original Fill

Katie Louise Fenn
Oaklands
Old Icknield Way
Benson
Wallingford
Oxon
OX10 6PW
In capacity as proprietor of the Original Fill

John Creigh Frost and Pamela Frost
19 Newham Green
Crowmarsh
Wallingford
Oxon
OX10 3EW
In capacity as proprietor of the Original Fill

Noel Henry Frost
Polruan
Oakley Wood
Benson
Wallingford
Oxon
In capacity as proprietor of Cell One

Ralph John Frost
19 Newnham Green
Wallingford
Oxon
In capacity as proprietor of Cell One

Noel Henry Frost
18 Hamleden Drive
Wallingford
Oxon
In capacity as proprietor of Cell One

References:

AEAT (June 2001) Oakley Wood Landfill: Remediation – Stage 1. RD03237

Contaminated Land (England Regulations) 2000 Statutory Instrument 2000 No 227

DETR Circular 02/2000 Environmental Protection Act 1990: Part IIA Contaminated Land 20th March 2000

Determination of Land at Cells Zero, One and the Original Fill at Oakley Wood Landfill as Contaminated Land, 2006

Environmental Protection Act 1990 Part IIA/ Section 78

Craig. H (June 2005). Oakley Wood Landfill Site –Determination. Environment Agency REF: EQ/G/CL/PartIIA

Towler. P, (September 2004) Oakley Wood: Groundwater Sampling for List 1 Substances. Serco Assurance

Determination of Land at Cells Zero, One and the Original Fill at Oakley Wood Landfill as Contaminated Land

Environmental Protection Act 1990 Part IIA; Sections 78A(2) and 78B(1)

1. This Determination has been prepared in accordance with paragraph 52 of Chapter B of Annexe three of the Department for Environment, Transport and the Regions (DETR) Circular 02/2000 and has been prepared by Darren Detheridge "the Contaminated Land Officer" of South Oxfordshire District Council "The Local Authority".

2. In accordance with the Guidance set out in Chapter A of Annexe three of the DETR Circular 02/2000 ("Chapter A"), and Part Four of Chapter B of Annexe three of DETR Circular 02/2000 ("Chapter B Part Four"), The Local Authority has identified the land as described in Schedule One below ("the land") as contaminated land as defined in Section 78A(2) of the Environmental Protection Act 1990 ("the 1990 Act").

3. Based on evidence set out in Schedule Two of this document, and following an assessment of that evidence as set out in Schedule Three of this document it appears to the Local Authority that the land is affected by the significant pollutant linkages set out in Schedule Four and in accordance with table B Chapter A of the DETR Circular 02/2000 such that there are two separate grounds for this determination, namely that:

    i) There is a significant possibility of significant harm to human health and of damage to property resulting from the production of carbon dioxide and methane gaseous contamination originating from Cells Zero, One and Original Fill of Oakley Wood Landfill and their accumulation in confined spaces within residential and commercial properties.

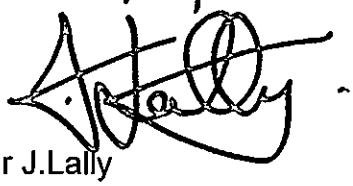
    ii) Pollution of controlled waters is being caused due to the presence and leaching of ammonia and manganese from Cells Zero, One and the Original Fill, and from the presence and leaching of chlorinated hydrocarbons and BTEX into controlled waters from Cells Zero and One.

4. In accordance with Section 78F(2) of the 1990 Act, Oxfordshire County Council have been identified as Appropriate Persons (Class A) for the reason set out in Schedule Five to this document.

5. The Local Authority hereby considers that the requirements of Chapter A and Chapter B, Part Four of the DETR Circular 02/2000, have been satisfied, for the reasons set out in Schedule Six to this document.

6. The statutory consultees are specified in Section 78B(3) of the 1990 Act and are listed in Schedule Seven to this document.

Dated: 14/06/2006



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Index

Figures

Tables

Abstract

Oakley Wood was formerly a sand and gravel quarry. In 1982 Oxfordshire County Council (OCC) obtained a license to dispose of inert, domestic and industrial wastes into Cells Zero, One and the Original Fill with no special engineering requirements to contain the waste.

Environmental consultants AEAT and Serco Assurance Ltd were commissioned by OCC to investigate the risks that Oakley Wood Landfill may pose to the environment and to local residents. In light of the findings of these investigations, South Oxfordshire District Council 'The Council' consider that Cells Zero, One and the Original Fill at Oakley Wood Landfill pose a significant risk to local residents, their property, ground water and local groundwater abstractions.

These significant risks are as follows:

1. There is a significant possibility of significant harm to human health and damage to property (buildings) resulting from the methane (CH_4) and carbon dioxide (CO_2) gaseous contamination, generated by Cells Zero, One and the Original Fill of Oakley Wood Landfill and their accumulation in confined spaces in local residential and commercial properties to the South of Cells Zero and One, and to the South of the Original Fill.

2. Pollution of controlled waters is occurring from the leaching of ammonia from Cells Zero, One and the Original Fill and from the leaching of chlorinated solvents (Trichloroethene, Tetrachloroethene and Vinyl Chloride) and BTEX contaminants (Benzene and Xylene) from Cells Zero and One of Oakley Wood Landfill.

To ensure that works are undertaken to mitigate these risks, 'The Council' have prepared this document determining Cells Zero, One and the Original Fill of Oakley Wood Landfill as land that is contaminated land as defined in Part IIA of the Environmental Protection Act 1990. This contaminated land determination has been prepared in accordance with the Department for Environment, Transport and the Regions (DETR) Circular 02/2000 statutory guidance.

Schedule One 'The Land'

Site	**Oakley Wood Landfill Site**
Cells	**Zero, One and the Original Fill**
Operator	**Oxfordshire County Council**
Grid Reference	**NGR SU 640890**

This determination has been carried out by Darren Detheridge (Contaminated Land Officer) in the Environmental Protection and Licensing Team at South Oxfordshire District Council 'The Local Authority'.

Contact details
TEL 01491 823214
FAX 01491 823201

This record forms a scientific and technical assessment of the site in accordance with the DETR Circular 02/2000 and explains 'The Local Authority's' decision to determine Cells Zero, One and the Original Fill of Oakley Wood Landfill site, Oakley Wood, Benson, South Oxfordshire, Oxford as contaminated land under the provisions of Part IIA of 'the 1990 Act'.

1.1 Background

Oakley Wood Landfill Site is a former sand and gravel quarry that was owned by Amey Roadstone Corporation (ARC) and Mr Garner. It was first used as a landfill in 1982. Oxfordshire County Council (OCC) were licensed to accept inert, commercial, household and a small amount of industrial wastes into Cells Zero, One and the Original Fill.

When the original phase of landfilling, known as 'Original Area' reached capacity in early 1987, the remaining quarry was divided into seven cells; Cell Zero, One, 2a, 2b, Three, Four and Five.

A vent trench exists in the North West corner of the Original Fill. It is thought that the trench was constructed in 1989. It does not extend the full depth of the waste and it may have been sited within the waste. No further information is available on the vent trench.

Upon reaching capacity Cell Zero was covered with chalk and then grassed, whilst Cell One was covered with silt. Landfilling of these Cells is thought to have occurred between 1989 – 1992. Cells Zero, One and the Original Fill were designed based on the dilute and disperse model so that any contamination would be attenuated/ dispersed by the environment, thus no engineering or contamination containment measures were implemented during any stage of design or infilling of these cells.

Filling of Cells 2a and 2b started in October 1992 and were operated with engineered clay liners and clay side walls. Leachate collection measures were installed in these cells but no active controls for landfill gas such as use of blowers

to move gas through pipes, which are embedded in the landfill were incorporated. Some passive venting was installed which involves single pipes imbedded in the landfill, allowing gas to flow freely from the waste to the atmosphere. These two cells were capped with bare soil comprising chalk/ marl/ clay mixture. The site ceased accepting wastes and closed in October 1994.

Cells Three and Four are currently being infilled with inert wastes. There are no plans to fill Cell Five and the civic amenity area may be moved to this location.

The ownership of Oakley Wood Landfill has been passed from OCC to Oxfordshire Waste Ltd (OWL). OWL were subsequently acquired by Greenways, which later changed its name to Hanson.

1.2 Area of Contaminated Land

Figure One shows the extent of the 'contaminated land' comprising Cells Zero, One and the Original Fill. Figure two shows the general location of Oakley Wood Landfill Site.

The evidence for determining Cells Zero, One and the Original Fill as contaminated land is contained in Schedule Two, an assessment of this evidence is contained in Schedule three and the significant pollutant linkages detailed in Schedule Four. A summary of the reasons why Cells Zero and One and the Original Fill have been determined as contaminated land is briefly explained in 1-2 below:

1. There is a significant possibility of significant harm to human health and damage to property (buildings) resulting from the methane and carbon dioxide gaseous contamination, generated by Cells Zero, One and the Original Fill of Oakley Wood Landfill and their accumulation in confined spaces in local residential and commercial properties to the South of Cells Zero and One, and to the South of the Original Fill.

2. Pollution of controlled waters is occurring from the leaching of ammonia from Cells Zero, One and the Original Fill and from the leaching of chlorinated solvents (Trichloroethene, Tetrachloroethene and Vinyl Chloride) and BTEX contaminants (Benzene and Xylene) from Cells Zero and One of Oakley Wood Landfill.

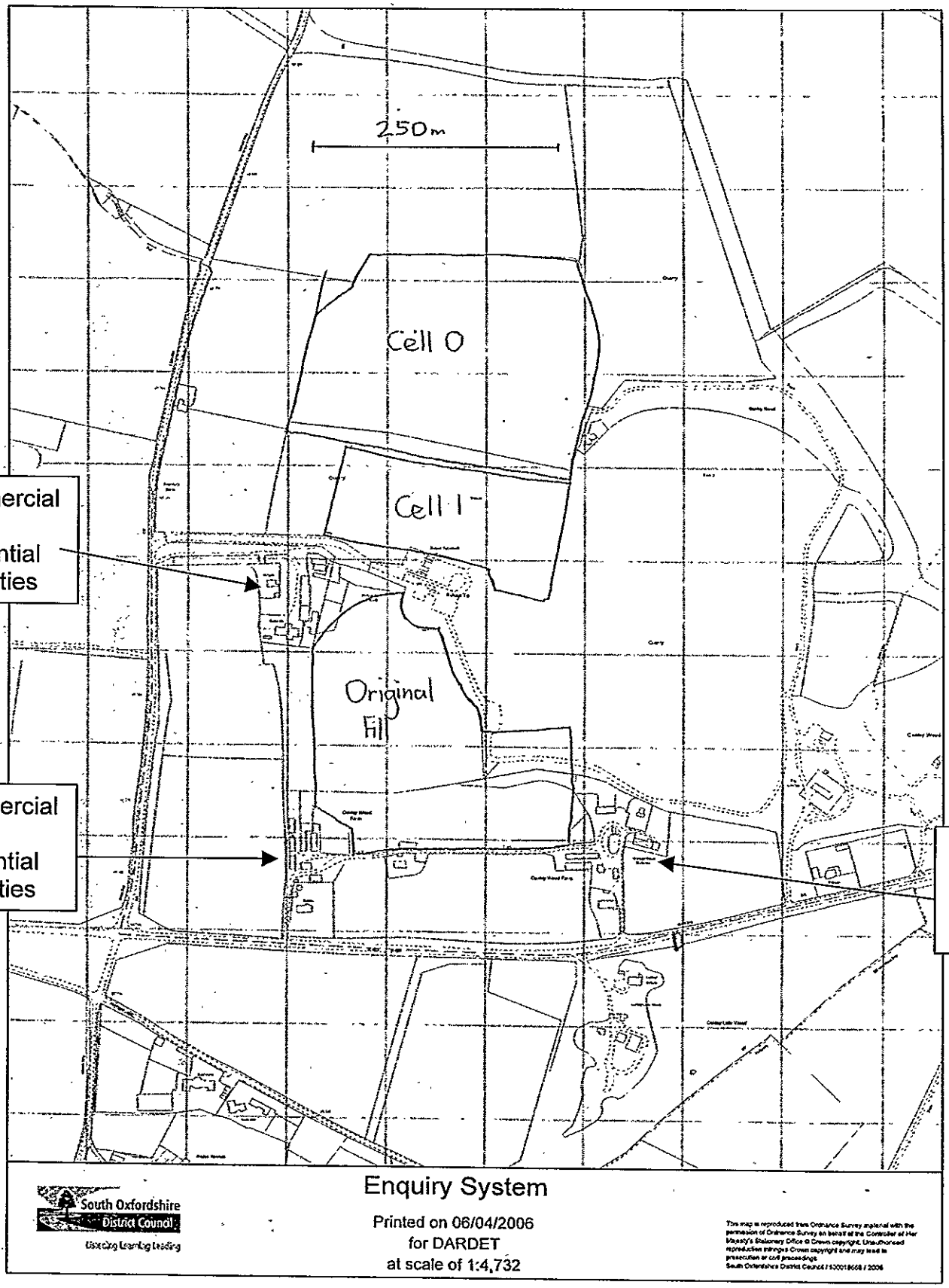

Figure One: Map Illustrating Location of Oakley Wood Landfill Cells Zero, One and the Original Fill

Figure Two: General Location of Oakley Wood Landfill Site

The following Schedule Two will provide the evidence upon which this determination is based. An assessment of this evidence will be provided in Schedule Three.

Schedule Two - Summary of evidence upon which the determination is based

Evidence for this determination has been obtained from a number of Oakley Wood Landfill site investigation reports (see references). This schedule provides a summary of the investigation results that have been used in this determination. In this assessment, Cells Zero and One have been considered separately from the Original Cell as different contaminants are present. Separation of Cells 0 and 1 from the Original Fill also allows for the significant pollutant linkages listed in Schedule Four to be more cell specific, thereby helping to focus the required remedial/ clean up works. Assessment Guidelines used include the United Kingdom Drinking Water Standards (UK DWS) and Environmental Quality Standards (EQS).

2.1 Landfill Gas

To establish appropriate assessment criteria for the concentrations of methane (CH_4) and carbon dioxide (CO_2) detected on and around Oakley Wood Landfill Site, a range of literature was reviewed. The first data source reviewed was the landfill gas assessment criteria used by AEA Technology (AEAT) Consultants in their Oakley Wood investigation reports. This data is presented in the following table:

Table One: AEA Technology Landfill Gas Assessment Criteria

Classification	**Threshold % volume in air**	
	CH_4	**CO_2**
Zero or below the limit of detection	≤0.1%	≤0.1%
Low	>0.1%	>0.1%
Elevated	>0.5%	>1.5%
High	>5%	>10%

To determine whether the AEAT assessment criteria was appropriate for use in this determination, three other sources including the CIRIA 149, Waste Management Paper 27 and BRE 212 were reviewed.

Hazardous concentrations of methane and associated landfill gases derived from CIRIA 149 Protecting Development from Methane (1995) are provided in the following table:

Table Two: CIRIA 149 Hazardous concentrations of Methane and Carbon Dioxide

	Hazard Concentrations	
	Toxicity of asphyxiation % by volume in air[1]	**Explosive limits in air % by volume in air (LEL)[2] (UEL)[3]**
CH_4	30	5.0-15.0
CO_2	0.5	Not applicable

[1] Eight hour long term exposure limit (HSE, 1991)
[2] Lower explosive limit
[3] Upper explosive limit

Waste Management Paper 27 recommends that housing should not be built within 50m of a landfill site boundary and that gardens should not extend to within 10m of the wastes. In addition the guidance recommends that housing should not be built where methane and carbon dioxide concentrations exceed 1% by volume and 1.5% by volume respectively. The reason being that gas may accumulate in sheds, greenhouses and extensions and that heat from bonfires may result in underground fires.

BRE (2002) Construction of New Buildings on Gas Contaminated Land recommends the following guidelines for methane and carbon dioxide ground contamination:

a) If methane concentrations in the ground are unlikely to exceed 1% by volume and a house or similar building is constructed with a floor built in a manor specified in the document, then no further protection is required.
b) If carbon dioxide concentrations in the ground are above 1.5% by volume then floor constructions such as those specified in the BRE document should be considered to prevent gas ingress. For concentrations in the ground above 5% by volume, the specified gas protection floor measures are required.

In the June 2000 Report by AEA Technology (AEAT) the results of approximately 10 years of monitoring were interpreted. This data showed that concentrations of between 30% –60% methane and up to 35% carbon dioxide was present within the waste in the 'Original Fill' material and concentrations of up to 35% methane and up to 23% carbon dioxide were detected on the boundary of this cell and migrating out of the cell's boundary (June, 2000). Concentrations of 30% methane and 23% carbon dioxide were detected at approximately 20m distance from commercial properties to the South of the Original Fill (June, 2000).

In June 2001, gas monitoring at Oakley Wood Landfill identified concentrations of methane up to 58.7% and carbon dioxide up to 33.6% migrating towards residential and commercial properties to the South of the Original Fill. Near to a commercial premises that is approximately 10 metres distance from the Original Cell, methane was detected at 17.4% and carbon dioxide at 25.3% (June 2001).

AEAT report that a substantial amount of biodegradable waste exists within the Original Cell and if the conditions within the waste mass changed such as moisture content or temperature, that gas production rates could rise significantly (October, 2000). Also reported is that there is a significant risk and potential for landfill gas migration beneath property's adjacent to the Original Fill, but this risk is falling over time. The majority of the data from monitoring wells around residential receptors that lie within 25 metres of the Original Cell indicate low values for carbon dioxide and methane in most cases. Monitoring for gaseous contamination within these residential and commercial properties has detected no evidence that methane or carbon dioxide has migration into the properties (October, 2000).

In the Landfill Cells Zero and One concentrations of up to 60% methane were found to be migrating in a Southerly direction at approximately 26m and 60m from

commercial and residential properties. The extent of methane migration was unknown. Concentrations of 24% methane and 15% carbon dioxide were detected in a Southerly direction at 10m distance from a commercial premises. Concentrations of CO_2 up to 38% were migrating from both Cells with 11% detected at approximately seven metres from a residential dwelling to the South West of the cells. Maximum concentrations of up to 60% were measured on Cell One (June, 2000).

Methane concentrations are consistently above 50% on Cells Zero and One with no evidence that these conditions will change in the short term. Maximum concentrations of approximately 60% methane and 35% carbon dioxide was measured adjacent to a commercial premises that is located in a Southerly location from the Cells (June 2001).

Migration of gaseous contamination is occurring towards residential and commercial properties at 50 metres to the South of Cell One with high concentrations of methane and carbon dioxide being consistently identified on most sampling visits around these properties (October 2000).

As with the Original Cell, AEAT Report that there is a considerable amount of organic material remaining in the Cells Zero and One and there is evidence that if the conditions within the waste mass changed that the gas production rates could rise significantly. There is also evidence of landfill gas from these Cells impacting local vegetation (October 2000). A passive vent trench was recommended to protect the residential properties (October 2000). See Peter Brett Associates (November 2003) Report on the In-ground Gas Barrier REF: 11860/001 for more information on the proposed vent trench.

Monitoring data from May 2000 until March 2001 also indicate that landfill gas is migrating towards residential and commercial properties to the South of Cells Zero and One, and towards commercial and residential properties to the South of the Original Fill. No landfill gases were detected inside the residential and commercial properties during the monitoring. The consultants AEAT state that a viable pollutant linkage exists between Oakley Wood Landfill site and the residential properties (June 2001). The migrating Landfill gas has been claimed to be attributed to Cells Zero and One and controls should be implemented to prevent migration of gases from these Cells. Gas production rates would be accelerated in all Cells if moisture content of the waste was to increase (optimum moisture content for CO_2 production is 65%, optimum moisture content for methane production is greater than 65% while observed moisture content was 30% water by weight in the Original Cell and <20% in Cells Zero and One. Substantial amounts of biodegradable waste remain within Cells Zero, One and the Original Cell (June 2001).

In summary, landfill gas has been identified to be migrating at high concentrations towards commercial and residential properties to the South of Cell One and to the South of the Original Fill. No flow rates were recorded in any of existing monitoring points in the June 2000 monitoring by AEAT and no landfill gases were detected in any of the commercial or residential properties during any of the monitoring within any local properties. The consultants AEAT recommend remediation via a vent

trench South of Cell One to protect the commercial and residential properties in this area.

Lower landfill gas concentrations were identified in Cells 2a, 2b, three and four. Passive venting in Cells 2a and 2b has been deemed partially effective by the consultants AEAT.

One elevated methane concentration of 18.7% was identified outside the boundary of Cell 2a (June, 2000). The nearest property to Cells 2a and 2b is at >250 metres distance.

Maximum concentrations of 18.5% CO_2 outside the boundary of Cell 4 (eastern side) were found with the nearest property at approximately 100m distance (June, 2000).

2.2 Groundwater Contamination

For land to be determined as contaminated land based on pollution of controlled waters the following criteria as specified in the DETR Circular 02/2000 must be satisfied:

1. The entry or likely entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter
2. Pollution must be continuing or likely to continue to enter controlled waters. The definition of likely being more likely than not to occur and the definition of continuing means any additional entry to that which has already occurred.

Therefore for pollution of controlled waters to occur from Oakley Wood Landfill Site the Local Authority must be satisfied that contaminants are likely to enter a controlled water and that a source for the contamination exists which would continue to allow the contaminants to enter the controlled waters.

The evidence used to illustrate that pollution of controlled waters has occurred from Oakley Wood Landfill is the direct measurement of the contaminants in controlled waters (groundwater under the landfill).

The evidence used to satisfy the Local Authority that contamination will continue to enter controlled waters is the leach testing that has been undertaken on waste materials at the Oakley Wood Landfill. These tests measure the amount of each contaminant that will leach from the landfill waste and which could potentially migrate into controlled waters. Standing leachate testing has also been used in this assessment as it illustrates the concentrations of the contaminants that have leached from the waste material.

In June 2000 AEAT identified a number of substances that are predicted to leach, at concentrations likely to exceed their respective groundwater assessment criteria. These contaminants and the criteria against which they were assessed are given in the table below. Due to the large amount of sampling results that are available for Oakley Wood, it was decided to only include the maximum measured concentrations in this assessment. This measurement has been used as the 1990 Act only requires the Local Authority to demonstrate that pollution of controlled waters is occurring or is likely to determine land as contaminated land. Maximum measured concentrations of each contaminant are therefore sufficient evidence for this determination.

Table Four: Leaching Potential of Contaminants from Oakley Wood Landfill

Contaminant	Max Measured Leaching Concentration	Assessment Criteria
Dichloromethane	3517ug/l	20ug/l (WHO Guidelines for Drinking Water)
Benzene	67ug/l	1ug/l (UK DWS – Drinking Water Standard)
Trichloroethene	3613ug/l	10ug/l (UK DWS)
Toluene	3204ug/l	700ug/l (WHO Guidelines for Drinking Water)
Tetrachloroethene	3371ug/l	10ug/l (UK DWS)
Ethylbenzene	8194ug/l	300ug/l (WHO Guidelines for Drinking Water)
Xylene	4517ug/l	500ug/l (WHO Guidelines for Drinking Water)
Napthalene	1527ug/l	10ug/l (UK EQS)
Vinyl Chloride	308ug/l	0.5ug/l (UKDWS)
Calcium	683.4mg/l	250mg/l (UK DWS)
Iron	16.82mg/l	0.2mg/l (UK DWS)
Manganese	8.33mg/l	0.5mg/l (UK DWS)
Ammonium	76.9mg/l	0.5mg/l (UK DWS)
Potassium	90mg/l	12mg/l (UK DWS)
Sulphate	1202mg/l	250mg/l (UK DWS)

Contaminants identified in standing leachate in the June 2000 investigation by AEAT are presented in Table Five below. This table includes those contaminants that exceed their groundwater target concentrations or those that were predicted to leach at unacceptable concentrations in Table Four above.

Table Five: Concentrations of Contaminants in the Standing Leachate

Contaminant	Max Measured Leachate Concentration	Assessment Criteria
Dichloromethane	<1ug/l	20ug/l (WHO Guidelines for Drinking Water)
Benzene	13ug/l	1ug/l (UK DWS)
Trichloroethene	<1ug/l	10ug/l combined
Tetrachloroethene	<1ug/l	
Toluene	313ug/l	700ug/l (WHO Guidelines for Drinking Water)
Ethylbenzene	109ug/l	300ug/l (WHO Guidelines for Drinking Water)
Xylene	210ug/l	500ug/l (WHO Guidelines for Drinking Water)
Napthalene	97 ug/l	10ug/l (UK EQS)
Vinyl Chloride	<1ug/l	0.5ug/l (UKDWS)
Calcium	289.5mg/l	250mg/l (UK DWS)

Iron	7.17mg/l	0.2mg/l (UK DWS)
Manganese	6.15mg/l	0.5mg/l (UK DWS)
Ammonium	470mg/l	0.5mg/l (UK DWS)
Potassium	600mg/l	12mg/l (UK DWS)
Sulphate	55mg/l	250mg/l (UK DWS)
Nickel	0.2mg/l	0.02mg/l (UK DWS)
Sodium	850mg/l	850mg/l (UK DWS)
Chloride	660mg/l	250mg/l (UK DWS)
Styrene	22ug/l	20ug/l (WHO Guidelines for Drinking Water)

In an assessment of the risk to the groundwater from Oakley Wood Landfill by Serco Assurance Consultants in October 2000, it was predicted using a groundwater contamination modelling package called Consim that there is a significant possibility that particularly Ammonium and to a lesser extent Manganese will exceed target concentrations in the groundwater beneath the site. The presence of certain contaminants being present in the groundwater before it reached Oakley Wood Landfill made it difficult to attribute other contaminants to the Landfill due to the proximity of other potential sources of contamination (October 2000). The absence of contaminants in the standing leachate such as Dichloromethane, Trichloroethene, Tetrachloroethene, Vinyl Chloride that have potential to leach at elevated levels from Oakley Wood Landfill added extra confusion as their presence in the standing leachate would be expected. As was the presence of contaminants such as Styrene, Nickel, Sodium and Chloride in the standing leachate because they were not identified in the leach testing as having the potential to leach at elevated concentrations from the waste material Oakley Wood Landfill.

The latest groundwater monitoring undertaken by Serco Assurance in June, August and October 2004 identified a number of list One substances in the groundwater that exceeded their UK assessment criteria. These contaminants are listed in the following table.

Table 6: Concentrations of Contaminants in the Groundwater

Contaminant	**Max Concentration Measured**	**Assessment Criteria**
Trichloroethene	30ug/l Combined	10ug/l Combined UK DWS
Tetrachloroethene		
Vinyl Chloride	7ug/l	0.5ug/l (UKDWS)
Benzene	3ug/l	1ug/l (UKDWS)
Xylene	64ug/l	30ug/l (UK EQS)
Nitrate	84.4mg/l	50mg/l (UKDWS)

As the Environment Agency (EA) regulate contamination of controlled waters, they were consulted for their view on the contamination of groundwater from Oakley Wood Landfill. In response, the environment Agency stated that there is evidence of chlorinated solvents migrating from at least Cells Zero and One with elevated levels of Tetrachloroethene (PCE), Trichloroethene (TCE) and Benzene in the groundwater that exceed their respective Drinking Water Standards (DWS). In light

of the most recent monitoring information, the EA stated that if the site is determined as contaminated land, that it would appear to satisfy the conditions of Regulation 3c of the Contaminated Land (England) Regulations 2000 for a Special Site as the above contaminants are list One substances, the contaminated groundwater is a listed Chalk aquifer and leach tests have demonstrated that these contaminants are leaching from Oakley Wood Landfill (Hampton. C, October 2004; Hampton. C, June 2005). The leach tests therefore illustrating that there is a continuing source of the contamination which is a requirement of the '1990 Act' for the site to be determinated as contaminated land based on pollution of controlled waters.

AEAT recommend in their remediation strategy that the Original Cell and Cells Zero and One should be capped with granular material to reduce leaching of contamination into the groundwater (June 2001).

The effect of a capping layer on the contaminants migrating from the landfill was modelled using a groundwater model called Consim. This indicated that the concentrations of contaminant in the groundwater will be reduced but that this reduction is not pronounced due to vertical dispersion of contamination in the relatively thick unsaturated zone and contamination being in close contact with groundwater. The long term benefits of the capping layer would be to limit flushing of contaminants still in the waste pits (October 2002).

A cost benefit analysis was recommended to determine whether the benefit to groundwater quality is justified when set against the cost of capping (October 2002).

2.3 Private Water Abstractions

Groundwater abstractions are present at local farms, the closest being 700m from Oakley Wood Landfill in the anticipated direction of ground water flow (down groundwater gradient).

Serco Assurance Ltd Consultants (Serco) have reviewed the groundwater monitoring data available for the private water abstractions at farms down groundwater gradient from Oakley Wood Landfill and those in the opposite direction to the expected groundwater and contamination flow. Serco claim that agricultural sources may be responsible for the Nitrate and Ammonium contamination of the private water abstractions as the down groundwater gradient contamination is consistent with the up ground water gradient contamination. This indicates that the groundwater is contaminated before contaminants could have leached into the ground water from Oakley Wood Landfill.

In the consultants assessment of the investigation data it was predicted using the Consim model that there is a 15% probability of ammonium exceeding 1mg/l (DWS is 0.5mg/l) at the nearest private water abstraction. Manganese, ammonium, trichloroethene and tetrachloroethene are predicted to exceed DWS in approximately 70% of cases considering dilution alone and not considering other environmental impacts. Trichlorofloromethane was detect at low concentrations at the nearest farm private water abstraction 700m down groundwater gradient from

the site but was not encountered at the Landfill monitoring points indicating impact on the abstraction from other sources (October, 2002).

In May 2000 Serco detected 4ug/l of Trichlorofluromethane in the borehole at the nearest farm but no apparent source at Oakley Wood Landfill Site. However from the June and August 2004 monitoring this contaminant was detected in the groundwater at Oakley wood at concentrations up to 43ug/l. Following these results, Serco stated in a letter dated 3rd September 2004 that there would appear to be a hydraulic link between the landfill and the farm abstraction 700m distance from the site. Serco also stated research has revealed that chlorofluromethanes would appear to be not uncommon constituents of landfill leachate (Towler. P, September 2004).

However, the 4ug/l of Trichlorofluromethane detected in the private water abstraction does not have any UK assessment criteria and when assessing this contaminant against non UK criteria, it is below the New York State Health Department Guideline for Drinking Water of 5ug/l.

A summary of the evidence reviewed in this schedule and the criteria against which this evidence has been assessed is presented in the following table:

Table Seven: Summary of Evidence Used in this Determination

Pollutant Linkage	**Contaminant / Landfill Source**	**Pathway**	**Receptor**	**Assessment Criteria (Significant Harm/ Pollution of controlled water)**	**Evidence of significant possibility of significant harm or pollution of controlled waters**
a	Methane/ **Cells 0 and 1**	Migration through wastes soils and strata and building structures and accumulation in confined spaces	Human	Significant possibility of significant harm by explosion >0.5% Elevated >5% High	**>5% CH_4 encountered near to properties.** Concentrations of upto 60% detected outside the Fill boundary at 26m and 60m from residential and commercial premises. 24% CH_4 detected at 10m distance from a commercial premises. Maximum concentrations of over 60% methane was measured adjacent to commercial properties.
b	Carbon Dioxide/ **Cells 0 and 1**	Migration through wastes soils and strata and building structures and accumulation	Human	Significant possibility of significant harm by asphyxiation >0.5% Elevated >5% High	**>5% CO_2 encountered near to properties.** 24% CO_2 detected at 10m distance from commercial properties. 38% CO_2 detected outside the Fill boundary and 11%

		in confined spaces			detected at approximately 7m from a residential dwelling.
c	Methane/ **Cells 0 and 1**	Migration through wastes soils and strata and building structures and accumulation in confined spaces	Buildings	Significant possibility of significant harm by explosion >0.5% Elevated >5% High	**>5% CH_4 encountered near to properties.** Concentrations of upto 60% detected outside the Fill boundary at 26m and 60m from commercial and residential properties. 24% CH_4 detected at 10m distance from a commercial property. Maximum concentrations of over 60% methane was measured adjacent to a commercial property.
d	Methane/ **original fill**	Migration through wastes soils and strata and building structures and accumulation in confined spaces	Human	Significant possibility of significant harm by explosion >0.5% Elevated >5% High	**>5% CH_4 encountered near to properties.** 30%, 17.4% CH_4 at 20m and 10m distance from a commercial premises (June 2000, June 2001). 35% and 58.7% CH_4 detected outside the Fill boundary in the direction of residential and commercial properties.
e	Carbon Dioxide/ **original fill**	Migration through wastes soils and strata and building structures and accumulation in confined spaces	Human	Significant possibility of significant harm by asphyxiation >0.5% Elevated >5% High	**>5% CO_2 encountered near to properties.** 23%, 25.3% CO_2 at 20m and 10m distance from a commercial property (June 2000, June 2001). 23% and 33.6% CO_2 detected outside the Fill boundary in the direction of residential and commercial properties.
f	Methane/ **original fill**	Migration through wastes soils and strata and building structures and accumulation in confined spaces	Buildings	Significant possibility of significant harm by explosion >0.5% Elevated >5% High	**>5% CH_4 encountered near to properties.** 30%, 17.4% CH_4 at 20m and 10m distance from a commercial property (June 2000, June 2001). 35% and 58.7% CH_4 detected outside the Fill boundary in the direction of residential and commercial properties.
g	Non List 1 Substances: Metals/ Non metals **Cells 0, 1**	Landfill leachate through unsaturated zone	Ground water	Pollution of controlled waters above DWS and EQS	Manganese Ammonium (see Schedule 2 for evidence of pollution of controlled waters with

	and original fill				these substances)
h	List 1 Substances: Chlorinated Solvents **Cells 0, 1**	Landfill leachate through unsaturated zone	Ground water	Pollution of controlled waters above DWS, EQS, WHO Guideline	Trichloroethene Tetrachloromethane Vinyl Chloride (see Schedule 2 for evidence of pollution of controlled waters with these substances)
i	List 1 Substances: BTEX/ PAH **Cells 0, 1**	Landfill leachate through unsaturated zone	Ground water	Pollution of controlled waters above DWS, EQS	Benzene Xylene (see Schedule 2 for evidence of pollution of controlled waters with these substances)
j	manganese / ammonium	Migration of contaminated ground water	Human	Pollution of private water supply above DWS	Evidence of private water supply contamination illustrates that pollution of these controlled waters exceeding DWS is likely to occur (see Schedule 2).

Schedule Three – Summary of the relevant assessment of the evidence upon which this determination has been made

Assessment of the evidence provided in Schedule Two has been undertaken by 'The Local Authority' and the consultants AEAT. The purpose of this assessment is determine the risk to humans and property from CH_4 and CO_2 generation from each of the Landfill Cells Zero, One and the Original Fill, and the pollution of controlled waters as a result of contaminants leaching from the waste material in these cells. Significant pollutant linkages are listed in Schedule Four where it is considered that a significant possibility of significant harm to humans or damage to property is likely, or where pollution of controlled water is occurring or is likely to occur.

3.1 Summary of the Assessment of Evidence Relating to Gas Contamination

The assessment of gaseous contamination from Cells Zero and One shall be undertaken separately from the Original Fill so that the receptors at risk can be attributed to either Cells Zero and One, or the Original Fill, thereby helping to focus the required remedial works.

3.1.1 Gas Contamination from the Original Fill Cell

The Local Authority is aware that a landfill gas barrier is present between the Original Fill and the commercial and residential properties to the North/ North West of this cell.

Due to the uncertainty in the construction, location and effectiveness of this landfill gas barrier, it is not possible to state whether or not the gaseous contaminants identified at these properties originated from the Original Fill. Attempts to investigate the effectiveness of this barrier have been unsuccessful due to its instability and part of the barrier collapsing during an investigation by Serco. This further questions the effectiveness of the gas barrier and whether the Original Fill is the source or part of the source for the gaseous contamination identified around the commercial and residential properties to the North of this cell.

AEAT have commented in their reports in regard to the above commercial and residential properties that;

> Other than a couple of monitoring points that could be attributed to Cell One, 'the remainder of the wells adjacent to the property show low or zero values for methane and carbon dioxide in most cases'.

This suggesting that the Original Fill may not be responsible for the elevated gaseous contamination near to the North/ North West commercial and residential properties. The consultants also state;

> The gas monitoring within these properties has revealed no evidence of migration into property (AEA Technology Risk Assessment: Interpretative Report for Oakley Wood Landfill, October 2000).

In respect of the commercial and residential properties to the South West of the Original Fill, the Local Authority consider that high concentrations of landfill gas migrating towards these properties is likely to be attributed to this Cell due to it being far closer to these properties than any other Cell at the Oakley Wood Landfill. For example, Cell Five is approximately 180 metres from these properties and Cell One is >300 metres compared to the Original Fill which is only 15 metres from the nearest property.

The Original Fill has been generating consistently high concentrations of methane and carbon dioxide over a number of years. Low flow rates were measured over the investigations. However high concentrations of both gases have been encountered near to the residential and commercial properties to the South West of the Original Cell.

AEAT have stated in their reports when considering the gas production from the Original Fill, that the;

> recent years monitoring results illustrates no significant gas migration from the cell (AEA Technology Risk Assessment: Interpretative Report for Oakley Wood Landfill, October 2000). Data from wells that serve this area of the site have not provided evidence of significant migration of landfill gas in recent years although historical data have shown migration has occurred from the original fill. (Oakley Wood Landfill Gas Migration Risk Assessment, June 2001).

This suggesting that gas production is low from the Original Fill and that remediation may not be required due to a falling risk from the gaseous contamination.

However AEAT also comment that;

> there remains a considerable amount of organic material within the fill and there is evidence that if the conditions within the waste mass changed, gas production rates could rise significantly' (Oakley Wood Landfill Gas Migration Risk Assessment, June 2001; AEA Technology Risk Assessment: Interpretative Report for Oakley Wood Landfill, October 2000).

Overall the assessment by AEAT concludes that there is a significant potential for landfill gas migration beneath property adjacent the original fill and that there is historical evidence of Landfill Gas migration from this Cell. The risk of this occurring is falling over time (Oakley Wood Landfill Gas Migration Risk Assessment, June 2001).

On review of AEAT's assessment and of the monitoring data the Local Authority consider that despite no gases being detected within the residential or commercial properties in this area, there is a significant possibility that this may occur due to

the proximity of these properties to the high concentrations of migrating landfill gases (for example 17.4% CH_4 and 25.3% CO_2 within 10m from a commercial premises). There is also a significant amount of biodegradable waste still remaining within the Landfill, which at the time of sampling, was not at optimum conditions for generation of landfill gases.

When comparing the evidence for gas contamination in Schedule Two against the assessment criteria for gaseous contaminants, the concentrations of CH_4 and CO_2 around the commercial and residential properties to the North and to the South of the Original Cell are high. The magnitude of the consequences from the concentrations of gaseous contaminants identified, are therefore very serious as the accumulation of either gas at the sensitive residential, or commercial properties that are susceptible to this contamination could cause significant harm through explosion or asphyxiation. There is also a significant possibility that the high concentrations of CH_4 could accumulate in confined spaces in the residential or commercial properties and cause damage to the buildings by explosion.

It is therefore considered that there is a significant possibility of significant harm to commercial and residential properties from the Original Fill and remediation is required.

Current gas protection measures proposed for the remediation of Oakley Wood Landfill do not appear to address the gaseous contamination migrating in a South Westerly direction from the Original Fill (see Peter Brett Associates report on the In-ground Gas Barrier 300m in Length and up to 10m Depth dated November 2003).

3.1.2 Gas Contamination from Cells Zero & One

The Local Authority considers that Cells Zero and One appear to be the source or a large part of the source for the elevated concentrations of landfill gas (CH_4 and CO_2) identified near to residential and commercial properties to the South of these Cells.

Cells Zero and One have been generating consistently high concentrations of CH_4 and CO_2 over a period of at least 10-15 years. Low flow rates were measured during the investigations but high concentrations have been measured near to residential properties and adjacent to commercial properties. Methane at concentrations >60% was measured adjacent to commercial properties and high concentrations of CO_2 of 24% and 11% were measured at 10m distance from commercial and at approximately 7m from residential properties to the South of these cells.

AEAT have commented in their reports with regard to the above residential and commercial properties in that;

> throughout the monitoring period there was no evidence of flow within wells, which had elevated or high levels of methane, and this reduces the risk of gas migration.

AEAT also state that;

> the landfill gas is likely to be migrating from Cells Zero and One in a Southerly direction towards residential properties but there is no evidence that landfill gas is migrating into the properties

Overall, the assessment by AEAT concludes that gas migration is occurring towards residential receptors to the south of Cell Zero and Cell One.

In assessment of the risk to the properties from the gaseous contamination, the consultants stated that;

> there is a viable pollutant linkage between the Oakley Wood Landfill site and the properties located [to the South] and that it seems likely that [some properties] are particularly vulnerable (Oakley Wood Landfill Gas Migration Risk Assessment, June 2001).

The Local Authority consider, despite no gases being detected in any of the residential or commercial properties in this area, that there is a significant possibility this may occur due to the proximity of these properties to the high concentrations of these migrating gases. This coupled by the significant amount of biodegradable waste still remaining within the Landfill, which at the time of sampling, was not at optimum conditions for generation of landfill gases.

When comparing the evidence for gas contamination in Schedule Two against the assessment criteria for gaseous contaminants also detailed in Schedule Two, the concentrations of CH_4 and CO_2 around these residential and commercial properties are high. The magnitude of the consequences from the concentrations of gaseous contaminants identified, are therefore very serious. The accumulation of either gas at the sensitive residential, or commercial properties that are susceptible to this contamination could cause significant harm through explosion or asphyxiation. There is also a significant possibility that the high concentrations of CH_4 could accumulate in confined spaces in the residential or commercial properties and cause damage to the buildings by explosion.

It is therefore considered that there is a significant possibility of significant harm from Cells Zero and One and remediation is required.

Gas protection measures have been proposed to prevent gaseous contamination migrating from these cells and in the direction of the residential and commercial properties (see Peter Brett Associates report on the In-ground Gas Barrier 300m in Length and up to 10m Depth dated November 2003.

3.2 Summary of the Assessment of Evidence Relating to Groundwater Contamination

During this assessment the List One contaminants as defined in Schedule One Regulation 3c of the Contaminated Land (England) Regulations 2000 have been separated from contaminants not listed in the regulations. This will allow assessment of contaminants which if found to be polluting controlled waters would mean that this site should be a special site for which the Environment Agency would then assume responsibility for regulation.

3.2.1 Groundwater Contamination with Non Listed Contaminants

The non listed contaminants that are present at significant quantities in the landfill waste at Cells Zero, One and the Original Fill and that have been predicted to be likely to leach into the groundwater at concentrations exceeding their assessment criteria/ target concentrations are: Calcium, Iron, Manganese, Nickel, Potassium, Sodium, Chloride, Ammonium and Nitrate.

Based on this information the Local Authority therefore consider that Cells Zero, One and the Original Fill constitute a source for these contaminants and that pollution of the underlying Chalk Aquifer is likely due to their potential to leach into the groundwater. These results do not consider dilution, dispersion, attenuation, retardation and degradation of the contaminants in the unsaturated zone (soils above the groundwater/ Chalk aquifer), before the contaminants reach the groundwater. When considering the groundwater monitoring data for these contaminants to determine how much have been buffered in the unsaturated zone, the results are quite confusing with elevated concentrations being detected in the opposite direction to the anticipated groundwater flow (up groundwater gradient). This implying that other sources could also be contaminating the groundwater. To determine the likely concentrations of these contaminants in the groundwater, Serco have used a model called CONSIM to predict the effects of dilution on the contamination within the unsaturated zone.

When using this model to consider the effects of dilution, it was modelled that chloride, sodium and nickel did not exceed their ground water target concentrations. Other contaminants including iron and potassium show low probabilities of exceeding their groundwater target concentrations. The only inorganic contaminants that were predicted to significantly exceed their groundwater target concentrations when considering dilution alone were manganese and ammonical nitrogen.

These findings are supported by the Environment Agency in numerous letters, one example being the letter from C. Hampton dated 14th July 2004 where it is agreed that Oakley Wood is contaminated Land because of the contamination of the groundwater with ammonium and manganese. Also explained in the letters are that other inorganic contaminants can not be attributed to Oakley Wood as elevated concentrations are detected up groundwater gradient and another source may be responsible for the groundwater contamination.

The Local Authority therefore consider that from Cells Zero, One and the Original Fill at Oakley Wood Landfill, that the Chalk Groundwater Aquifer has and is being polluted by manganese and ammonical nitrogen from these Cells and that contamination is likely to continue to occur in the future due to the existing source for this contamination.

3.2.2 Groundwater Contamination with Listed Contaminants

The listed contaminants that are present at significant quantities in the landfill waste at Cells Zero, One and the Original Fill and that have been predicted in an assessment by AEAT to be likely to leach into the groundwater at concentrations exceeding their assessment criteria/ target concentrations are Dichloromethane, Benzene, Trichloroethene, Toluene, Tetrachloroethene, Ethylbenzene, Xylene, Napthalene and Vinyl Chloride. This providing sufficient evidence that the pollution of the groundwater is likely with List One substance from Cells Zero, One and the Original Fill of Oakley Wood Landfill.

However, only Benzene and Napthalene were identified in the standing leachate at concentrations exceeding their groundwater target concentrations, thus indicating that the other contaminants may not be leaching from the Oakley Wood Landfill Waste. The lack of contaminants such as Trichlorethene, Tetrachloroethene, Dichloromethane and Vinyl chloride in standing leachate and the presence of these contaminants in similar concentration in up and down groundwater gradient monitoring locations indicate that any groundwater contamination with these contaminants could have be from an alternative source.

When reviewing the most recent groundwater monitoring data from 2004 to determine whether pollution of the Chalk Aquifer had actually occurred from Oakley Wood Landfill, this indicated that chlorinated solvents, in particular Trichloroethene, Tetrachloroethene and Vinyl Chloride are present in the groundwater down gradient from Oakley Wood Landfill. As these contaminants have also been predicted to be leaching at concentrations likely to exceed their groundwater target concentrations, it is thought likely that the groundwater contamination is a result of contaminants leaching from landfill waste at Oakley Wood Landfill.

The Environment Agency support this assessment in numerous correspondence (Craig. H, October 2004; Craig. H, June 2005) stating that if the site is determined as contaminated land, that it would appear to satisfy the conditions of Regulation 3(c) of the Contaminated Land (England) Regulations 2000 for a Special Site due to the pollution of the listed chalk aquifer with chlorinated solvents (trichlorethene and terachloroethene) and BTEX that appear to have originated from Cells Zero and One.

To date, Benzene, Trichloroethene, Tetrachloroethene, Xylene, Napthalene and Vinyl Chloride are the listed contaminants that have been identified in the Chalk Aquifer and were predicted to be leaching from the landfill waste at concentrations exceeding their target concentrations. Pollution of the Chalk Aquifer with these contaminants has occurred and is likely to continue to occur in the future as there is a source of these contaminants at Oakley Wood Landfill.

The low concentrations of Toluene in the standing leachate and in the groundwater monitoring, indicates that this contaminant is not polluting the Chalk Aquifer despite it being predicted that this contaminant would leach into the groundwater at concentrations exceeding its target concentration.

Elevated concentrations of Dichloromethane and Ethylbenzene were predicted to be in the leachate but were not identified in the standing leachate and at current there is insufficient information to determine whether pollution of the Chalk Aquifer is occurring with these contaminants.

3.3 Summary of the Assessment of Evidence Relating to Contamination of Private Drinking Water Supplies

A number of contaminants were modelled using a risk assessment package called CONSIM to predict the effect of dilution and natural attenuation between the source of the contamination at Cells Zero, One and the Original Fill and a private water abstraction at a farm 700m down groundwater gradient from the landfill.

Based on dilution alone, the contaminants that were predicted to exceed their groundwater target concentrations at the farm groundwater abstraction were potassium, iron, naphthalene, manganese, ammonium, trichloroethene, tetrachloroethene.

Serco Assurance have reported in their assessment of this data that 'the model is very conservative, as it assumes a continuous source term and excludes retardation (contaminants being retarded by soil/ geology) and degradation (broken down by migroorganisms)' and that 'the probability of potassium or iron exceeding the DWS at the farm is not significant'. This argument is accepted by the Local Authority. This same argument was used for naphthalene where a low probability of this contaminant exceeding its DWS was predicted which would be reduced further when considering retardation and degradation.

When considering retardation, degradation and dilution, it is predicted using CONSIM that only ammonium and manganese will exceed their target concentrations at Coldharbour Farm at some time in the future.

Groundwater monitoring has identified breaches of the target concentration for ammonium at the water supply in Coldharbour Farm but the consultants, Serco Assurance report that this is also the case for water quality up gradient from the site and suggest that the contamination may have originated from 'diffuse agricultural sources'. Serco also argue that 'the CONSIM model is conservative as it assumes an infinite source and that concentrations of manganese and ammonium at Coldharbour Farm would be significantly reduced over those predicted' if a finite source was modelled.

As a finite source has not been modelled, the results of the CONSIM model considering an infinite source, retardation, degradation and dilution have been used in this assessment and based on this modelling, the Local Authority consider

that pollution of a local private water supply is likely from manganese and ammonium.

The presence of Trichlorofluromethane in Oakley Wood Landfill and the borehole at the nearest farm appears to show a hydraulic link between Oakley Wood Landfill and the farm. This providing further evidence that the ammonium and manganese contamination identified in the farm abstraction may be from the Landfill and not from diffuse agricultural sources.

It should be noted that the Trichlorofluromethane detected in the private water abstraction does not have any UK assessment criteria and it is below the New York State Health Department Guideline for Drinking Water.

Schedule Four - Description of all the significant pollutant linkages

Cells Zero and One and the Original Fill of Oakley Landfill Site meet the definition of contaminated land as defined in Section 78A(2) of Part IIA of the 1990 Act, from the significant possibility of significant harm, and the pollution of controlled waters, by way of the significant pollutant linkages listed in a-j:

a-b.	**Significant possibility of significant harm to human health is present through asphyxiation and explosion from landfill gas (CO_2 and CH_4) generated by Cells Zero and One migrating to residential properties and commercial properties situated South of these Cells.**
c.	**Damage to property is likely by explosion resulting from the accumulation of landfill gas (CH_4) in residential and commercial properties to the South of Cells Zero and One.**
d-e.	**Significant possibility of significant harm to human health is likely by asphyxiation and explosion from the accumulation of landfill gas (CO_2 and CH_4) generated by the Original Fill Cell migrating to residential and commercial properties situated South of the Cell.**
f.	**Damage to property is likely by explosion resulting from the accumulation of landfill gas (CH_4) in residential properties and commercial properties to the South of the Original Fill Cell.**
g.	**Pollution of the Chalk Aquifer underlying the Oakley Wood Landfill site has occurred from the leaching of Ammoniacal Nitrogen and Manganese from landfill waste present in Cells Zero, One and the Original Fill Cell.**
h-i.	**Pollution of the Chalk Aquifer underlying Oakley Wood Landfill Site has occurred from the leaching of Chlorinated Solvents and BTEX from landfill waste present in Cells Zero and One.**
j.	**Pollution of commercial private water supplies is likely as a result of migrating groundwater contaminated with manganese and ammonium.**

Schedule Five - Determination of the Appropriate Person to bear Responsibility for Remediation

In accordance with Section 78F(2) of the 1990 Act, Class A Persons are those who have been defined as 'appropriate persons' to bear responsibility for contamination because they have caused or knowingly permitted a pollutant to be in, on or under the land. In the case for Cells Zero, One and the Original Fill at Oakley Wood Landfill Site, Oxfordshire County Council have been identified as potential Class A Persons as they operated and accepted waste into Oakley Wood Landfill which has caused the contamination current present.

Schedule Six - Summary of the way in which the authority considers that the requirements of Part A and B of the '1990 Act' have been satisfied.

The Local Authority has satisfied both Parts A and B of Part IIA of the 1990 Act for the site to meet the definition of contaminated land as there is a significant possibility of a 'human health effect' in the form of 'serious injury' as defined in Part three Table A of the DETR Circular 02/2000 from the accumulation of gaseous contaminants. More specifically the Local Authority is of the opinion that elevated levels of carbon dioxide and methane pose a significant possibility of significant harm. This is in the form of irreversible human health effects, on a substantial number of people by way of asphyxiation and explosion or fire defined in Part three Table B of the statutory guidance.

The Local Authority is also satisfied that a potential pollutant is present in, or under the land in question, which constitutes poisonous, noxious, or polluting matter, or which is solid waste matter and that the pollutant is entering controlled waters and will continue to enter controlled waters and that the requirements of Part four of the DETR Circular 02/2000 for the definition of pollution of controlled waters have been satisfied. More specifically, the Local Authority is of the opinion that ammonical nitrogen and manganese are leaching from contaminated landfill material at Cells Zero, One and the Original Fill and are polluting the underlying Chalk aquifer and that this contamination is likely to pollute local private water abstractions.

The Local Authority following advice from the Environment Agency is satisfied that pollution of the Chalk Aquifer is also occurring from chlorinated solvents and BTEX substances, namely Benzene, Trichloroethene, Tetrachloroethene, Xylene and Vinyl Chloride, that are leaching from contaminated landfill waste at Cells Zero and One.

As these contaminants are listed in Regulation 3c of the Contaminated Land (England) Regulations 2000 as 'organohalogen compounds' and 'mineral oils and other hydrocarbons', and the 'Upper Cretaceous Chalk' Aquifer being polluted is also listed in the said regulations, the site may fulfil the requirements for a special site. Following this determination the Local Authority shall consider the sites position in relation to it being a Special Site, in accordance with Section 18 of the 1990 Act.

Schedule Eight - Persons Notified of Determination in Accordance with Section 78B(3)

Environment Agency
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In capacity as a regulatory body

Chief Executive
Oxford County Council
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In capacity as the appropriate person

S Grundon (Ewelme) Limited of Estates Office
Grange Lane
Beenham
Berks
RG7 5PT
In capacity as proprietor of Fill Cell Zero

Noel Henry Frost
Polruan
Oakley Wood
Benson
Oxon
In capacity as proprietor of Fill Cell Zero

Noel Henry Frost
18 Hambleden Drive
Wallingford
Oxon
In capacity as proprietor of Fill Cell Zero

Jean Marion Fenn
Oaklands
Old Icknield Way
Benson
Oxon
In capacity as proprietor of the Original Fill

Patrick Michael Fenn
Oaklands
Old Icknield Way

Benson
Wallingford
Oxfordshire
OX10 6PW
In capacity as proprietor of the Original Fill

Katie Louise Fenn
Oaklands
Old Icknield Way
Benson
Wallingford
Oxon
OX10 6PW
In capacity as proprietor of the Original Fill

John Creigh Frost and Pamela Frost
19 Newham Green
Crowmarsh
Wallingford
Oxon
OX10 3EW
In capacity as proprietor of the Original Fill

Noel Henry Frost
Polruan
Oakley Wood
Benson
Wallingford
Oxon
In capacity as proprietor of Cell One

Ralph John Frost
19 Newnham Green
Wallingford
Oxon
In capacity as proprietor of Cell One

Noel Henry Frost
18 Hamleden Drive
Wallingford
Oxon
In capacity as proprietor of Cell One

References:

AEAT (November 1999) Oakley Wood: Qualitative Risk Assessment. AEAT - 6170

AEAT (June 2000) Oakley Wood Risk Assessment: Factual Report produced for Oxfordshire County Council AEAT/R/ENV/0058

AEAT (October 2000) Oakley Wood Risk Assessment: Interpretative Report. AEAT/R/ENV/0059

AEAT (June 2001) Oakley Wood Landfill: Remediation – Stage 1. RD03237

AEAT (June 2001) Oakley Wood Landfill Gas Migration Risk Assessment. AEAT/ENV/R/0630

AEAT (May 2002) Groundhog Survey of Oakley Wood Landfill. AEAT/ENV/R/1108

BRE (2002) Construction of New Buildings on Gas Contaminated Land

CIRIA 149 (1995) Protecting Development from Methane

Craig. H (July 2004). Oakley Wood Landfill Site. Environment Agency REF EQ/G/CL/SX/Part IIA

Craig. H (October, 2004). Oakley Wood: Groundwater Sampling for List 1 Substances. Environment Agency REF EQ/G/CL/SX

Craig. H (June 2005). Oakley Wood Landfill Site –Determination. Environment Agency REF: EQ/G/CL/PartIIA

Department of the Environment, her Majesty's Inspectorate of Pollution 2nd Ed (1991). The Control of Landfill Gas. Waste Management Paper 27, London, HMSO

DETR Circular 02/2000 Environmental Protection Act 1990: Part IIA Contaminated Land 20th March 2000

Environmental Protection Act 1990 Part IIA/ Section 78

Golder Associates (November 1994) Second Report on Groundwater Solvent Contamination, Ewelme and Oakley Wood Landfill near Wallingford, Oxon. 93515042/1

Serco (October 2002) Modelling of the Groundwater Flow and Contaminant Transport. RD03237001

Serco (May 2002) Oakley Wood: Boundary Investigation. RD03237001

Serco (September 2004) Oakley Wood: Outline Design for Closed Landfill Restoration & Cost-Benefit Analysis in Relation to Groundwater Contamination. SA/ENV/0707

Peter Brett Associates (November 2003) Oakley Wood Redundant Landfill Site Remediation Works, Oxfordshire County Council; In-ground Gas Barrier 300m in Length and up to 10m Depth. 11860/001

Peter Brett Associates (July 2003) Slurry Trench Cut-off Wall Design Philosophy Particular Specification and Overview. 2nd Draft

Towler. P, (September 2004) Oakley Wood: Groundwater Sampling for List 1 Substances. Serco Assurance

Appendix A Environment Agency Correspondence

This appendix contains the letters received from the Environment Agency regarding the ground water contamination at Cells Zero, One and the Original Fill and the Agencies position on whether these Landfill Cells could be regarded as a Special Site.

ENVIRONMENT AGENCY

Darren Detheridge
Environmental Health
South Oxfordshire District Council
Benson Lane
Crowmarsh Gifford
Wallingford
OX10 8NL

Our ref: EQ/G/CL/SX/PartIIA
Your ref:
Date: 22 June 2005

Dear Darren

Oakley Wood Landfill Site -Determination

I am writing in response to your email of 2 June 2005, which included a draft determination for the Oakley Wood Landfill. Sorry for the delay in getting back to you this was in part due to the fact the data exceeded the 10 Mb size for email transfer. I have enclosed the additional information you requested this includes:

Groundwater monitoring data from Serco on the CD Rom
A letter from P Towler of Serco with recent sampling for List I substances
A set of monitoring results from Egniol prepared for Oxfordshire County Council.

With regards to the groundwater issues relating to the determination, my views are basically the same as set out in my letter to you of 14 July 2004 with the modification following new chlorinated solvent results as set out in my letter to Phil Evans of 21 October 2004 and copied to you. However I will expand slightly on those summaries.

June 2000 AEA Tchnology Oakley Wood Risk Assessment :Factual Report. Section 3.3.3
17 samples of waste were taken where no free leachate was found. **Leach tests** were carried out on the soils and reported in Appendix 7. If you look at Appendix 7 for sample MW4 at 8.00m it shows TCE at 757 ppb, PCE at 24 ppb plus elevated BTEX compounds, or MW9A at 13.00m it shows TCE at 3613 ppb, PCE at 3371 ppb, plus elevated BTEX compounds. Similar patterns occur in MW8, MW1A & MW5. BTEX and Dichloromethane occur in most leachate samples. Interestingly 111 Trichloroethane does not occur in any of the results.

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www.environment-agency.gov.uk

If you look at the **Free Leachate** samples for these wells in Appendix 8, BTEX shows up at low concentrations but there is no evidence of chlorinated solvents. The situation in the **groundwater** is slightly different again with low levels of TCE and PCE detected in the groundwater wells but with little evidence of BTEX (although BTEX shows up in some the Egniol data). Also one or two other species appear in groundwater such as 111 trichloroethane and trichlorofluoromethane which hardly showed up in either the leachate samples from the soils or the free leachate.

Unfortunately the AEA report does not go into any detail about why these patterns occur. Basically, there appears to be the potential for List I contaminants in the fill to provide a source for the contamination detected in the groundwater down gradient of the site, however there is little evidence that this contamination is in the free leachate forming in the site. Also the nature of the leachate in terms of contaminant species looks different from what is detected in the groundwater and the free leachate. There could be some possible explanations that might explain the differences in these patterns. For instance the solvents could have largely leached out or evaporated out of the fill, so what we are seeing in the groundwater relates to the first flush. Alternatively there was never much solvent there in the first place. BTEX for instance would be related fuel oils which are LNAPLs which will tend to float on the surface of the leachate and remain in the smear zone of the fill. Chlorinated solvents as DNAPLs will tend to sink to the base of the leachate and possibly go further into the deeper aquifer, which may explain why BTEX is not observed in the groundwater offsite. However it is also possible to suggest that the solvent concentrations observed in the groundwater arise from alternative sources such as Ewelme Landfill, Woodside Farm scrap works etc. Some anomalous up gradient results give some creedence to this. Alternatively the patterns could be a combination of all of the above.

Off site receptors

Chlorinated solvents in the private supplies such as Lonesome Farm, Cold Harbour Farm around have always been at low levels over last 10 years since we have been monitoring them. They are always less than 1.5 ug/l, so well below the drinking water standard of 10 ug/l. but above background (see Table below).

	Trichloroethene		111- Trichloroethane		Ammoniacal Nitrogen	
Location	Mean	Max	Mean	Max	Mean	Max
Coldharbour Farm	0.76	1.23	0.38	0.79	<0.05	0.11
Lonesome Farm	1.01	1.47	<0.1	0.12	<0.05	0.05
Hill View	0.18	0.9	<0.1	0.2	<0.05	0.04
Woodside Farm	1.71	4.1	0.12	0.28	0.185	3.4

SVOCs

You also ask about the SVOCs. Generally they have not been detected in the groundwater with the exception of BH12, 13 & 14. The type of compounds detected appear to be mainly straight chain alkanes probably related to hydrocarbon contamination. These boreholes lie close to the access road and civic amenity area so this contamination could be related to run off rather than anything to do with the fill materials.

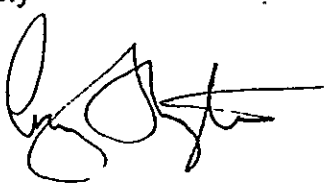
Cont/d..

Determination
You may be wondering, given some of the uncertainties above, whether it is appropriate to determine the site as contaminated land on these List 1species. I think the main issue is whether there is an significant pollutant linkage. Is there a source? The answer to that is yes, from the leachate samples. Is there a pathway? I feel the answer to that is yes based on the work done by AEA/Serco for the risk assessment for the ammonia pollution. Are the any receptors? Yes the private supplies are receptors, but the Chalk groundwater itself is a receptor. Groundwater monitoring around the site has drinking water standards exceeded for benzene and TCE & PCE. The level of water contamination is also not an issue at present as the 'significance' aspect for pollution of controlled waters has not yet been introduced by the new Water Act (2003).

In schedule 3, I would suggest having two groups of contaminant sources as 'Chlorinated solvents' and 'BTEX' then just appendix the individual species you want to include. West Berks did that for AWE and it helped to cut down the number of SPLs you have to list.

I hope this answers your questions, but please get back to me if you have any outstanding issues.

Yours sincerely



Craig Hampton
Technical Specialist (Contaminated Land)

Direct dial 01491 828425
Direct fax 01491 828302

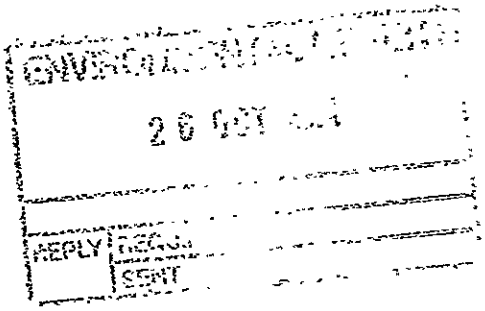
Cont/d..

Our ref: EQ/G/CL/SX
Your ref:

Date: 21 October 2004

ENVIRONMENT AGENCY

Mr Phil Evans
Environmental Services
Oxfordshire County Council
Speedwell House
Speedwell Street
Oxford
OX1 1NE



Dear Phil

OAKLEY WOOD: GROUNDWATER SAMPLING FOR LIST 1 SUBSTANCES

I am writing in response to Philippa Towler's letter to you of 3rd September 2004 and the related letter from Egniol Ltd to you of 13th October 2004.

The recent round of monitoring by SERCO Assurance showed levels of halogenated hydrocarbons similar to the pre October 2000 levels, which is evidence of groundwater migrating from the site with elevated levels of PCE and TCE. For instance boreholes BH 6,13 & 14 have groundwater in excess of Drinking Water Standards. I am afraid I did not find Egniol's reasons for the differences between the results convincing and in my experience chlorinated hydrocarbon levels do not usually fall to non detect levels in short timescales.

One of the main reasons for the additional groundwater sampling carried out on the boreholes at Oakley Wood was to help clarify, if the site was determined under the Part IIA Contaminated Land Regulations (2000), whether it would be a special site. Previous to this, I had stated my opinion, in a letter to Darren Detheridge of South Oxfordshire District Council, that although the site was contaminated land, due to contamination of groundwater by substances such as ammonium and manganese, it would not be a special site. This is because under Regulation 3(c) there are no SPLs for substances listed in Schedule 1. My opinion was based in part because recent monitoring results from boreholes on the down gradient side of the site had shown non detects for chlorinated hydrocarbons since October 2000.

For a site to be determined as contaminated land there must be a source in the land. Leachate results from soils show that the waste could be the source materials for the elevated levels in the groundwater. E.g. MW4 at 8 m has TCE at 757 ppb and MW9A TCE at 3613 ppb. The data appears to show that most elevated results come from cells 1 and 0. In the light of the new SERCO information I have reconsidered my previous opinion and for Cells 1 and 0 at least, if determined as contaminated land they would appear to satisfy the conditions for Regulation 3(c) namely contamination of the Chalk aquifer with chlorinated hydrocarbons.

Cont/d..

Environment Agency
ISIS House, Howbery Park, Wallingford, Oxon, OX10 8BD
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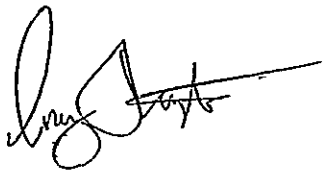
The new Water Act (2003) will introduce 'significance' to the pollution of controlled waters under Part IIA, but as yet this has not come into force. I mention this in passing as it may have implications depending on timescales for the determination. I would just say that levels are not highly elevated, so that it is not immediately apparent what would be an appropriate remedial strategy as I would expect that removal of wastes would not be an option on cost benefit analysis.

On a slightly different issue, thank you for the invite to the recent workshop on closed landfills. I think it would be useful if at some point I could see a summary of some of the groundwater monitoring data Oxford County Council has carried out on the other sites, so that I can concur with your assessment of level of environmental risk/impact.

If you require further clarification please do not hesitate to contact me.

Yours sincerely



CRAIG HAMPTON
Technical Specialist (Contaminated Land)

Direct dial 01491 828425
Direct fax 01491 828423

cc Nick Jefferies, Serco Assurance,
Darren Detheridge, SODC

Our ref: EQ/G/CL/SX/Part IIA
Your ref:

Date: 14 July 2004

ENVIRONMENT AGENCY

Darren Detheridge
Environmental Health
South Oxfordshire District Council
Benson Lane
Crowmarsh Gifford
Wallingford
OX10 8NL

Dear Darren

OAKLEY WOOD LANDFILL SITE

I am writing in response to your letter of 1st July 2004 and I will answer your questions in the order set out in that letter.

1. Like most landfills cells 0,1&2 are generating landfill leachate. The nature of this leachate varies with the nature of the original waste. The cells have varying thicknesses of attenuating layers which will moderate the impact any leachate produced. These factors will cause significant lateral and temporal variations in concentrations of contaminants as observed at the monitoring boreholes across the site. Bearing these variations in mind, the following species have been detected in groundwater above drinking water quality standards : Ammoniacal Nitrogen, Iron, Manganese, Nickel, Chromium Lead, Cadmium, Boron, Nitrate, Trichloroethene (TCE), Tetrachloroethane (PCE).

2. Of the species listed above, in recent monitoring rounds over the last three years, only Ammoniacal Nitrogen, Iron, Manganese, Nickel, Chromium and Lead have shown exceedances. In the case of nickel chromium and lead the exceedances have been mainly at Borehole 8 which is up hydraulic gradient of the site and Borehole 9 which is on the access road between cell 1 and 5 also largely up gradient of cells in question. Risk assessments and groundwater modelling have been carried out on the data from the site by AEA technology and SERCO which indicate that the ammoniacal nitrogen and to a lesser extent manganese can migrate offsite at levels above guideline values.

3. The main receptor in this area is the groundwater within the Chalk aquifer, This aquifer is used to provide potable supply at a number of locations around the site, but in particular at Coldharbour Farm which is 700 metres down hydraulic gradient from the Oakley Wood Site. At present the water quality at Coldharbour Farm shows little or no evidence of ammoniacal nitrogen contamination with most samples yielding results below detection limits. Coldharbour Farm however has yielded slightly

Cont/d..

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elevated levels of TCE, PCE and 111 TCA. There are problems in confirming simple pathways for significant pollutant linkages (SPLs) for these species. This is because the distribution is complex, in that other elevated results are recorded at Lonesome Farm, which is also down gradient, but also Woodside Farm (scrapyard) and Hill View, which are up gradient of the site. In addition monitoring at the Grundon's site at Ewelme also has returned elevated values of these species. So far the data is inconclusive as to whether Oakley Wood is the source of the elevated values of chlorinated solvents detected at Coldharbour Farm. They could be related to possible sources at Ewelme, Woodside Farm or even Coldharbour Farm itself.

Then there is the question of significance of pollutant linkages. The only pollutant linkages that can definitively be considered are those between the landfill and the groundwater under/adjacent to the site that are failing water quality standards, and those that can be demonstrated by modeling to be able to exceed water quality standards. At present, it is my opinion that only ammoniacal nitrogen and manganese can be demonstrated as significant contaminants.

4. In order for this site to qualify as a Special Site under Part IIA of the Environment Protection Act 1990 there is a need to first demonstrate pollution of controlled waters is being or is likely to be caused.

This I think is the case for the following SPLs

Pollutant	Source	Pathway	Receptor
Ammoniacal Nitrogen	Landfill	permeable soils	groundwater in the Chalk
Manganese	Landfill	permeable soils	groundwater in the Chalk

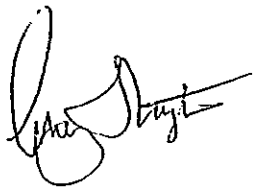
Under regulation 3(c) of the Contaminated Land Regulations (2000) although the Chalk is a listed aquifer in Schedule 1, ammoniacal nitrogen and manganese are not listed substances. At present there is insufficient evidence to demonstrate any listed substance such as chlorinated solvents are causing an SPL. Therefore the site is not a special site under regulation 3(c).

The other way this site may be considered as a special site would be under regulation 3(a), namely 'controlled water used for the supply of drinking water for human consumption'. Agency Guidance 'Technical Advice to Third Parties on the Pollution of Controlled Waters for Part IIA of the EPA 1990' states the term 'affected by' in regulation 3(a) does not imply that pollution of controlled waters must already be occurring. Therefore this means that adequate modeling could be enough to establish regulation 3(a) has been satisfied. Modeling carried out by AEA Technology using Consim demonstrated that after 1 million years manganese could breach environmental quality standards at Coldharbour Farm. Likewise ammonium had a maximum of a 15% probability of exceeding drinking water standards. This modeling, however, is believed to be conservative for the following reason. Consim uses a continuous source term, yet concentrations of leachate will fall with time. This is particularly relevant for manganese which the model requires a long time period to produce exceedance. The ammonium input parameters are heavily influenced by some high values detected in some of the standing leachate samples measured in the cell 0 (max value 470 mg/l). Other standing leachate samples (cells 1 & 2) are about an order of magnitude lower and similar to leachate tests carried out on the waste (average 34 mg/l). This would also tend to indicate a that leachate concentrations are declining with time.

Cont/d..

Therefore on the basis of the information above I think that the evidence from the modeling has not conclusively established that potable water at Coldharbour Farm will be affected by the Oakley Wood site for ammoniacal nitrogen or manganese. This means that on the information provided to date that although the site can be determined as contaminated land on the basis of the pollution of controlled waters it does not qualify as a Special Site.

Please contact me if you require further clarification of any of the above points.



CRAIG HAMPTON
Technical Specialist (Contaminated Land)

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Direct fax 01491 828423

Appendix B Serco Correspondence

This letter explains the results of some groundwater monitoring and concludes that the results suggest a hydraulic linkage between the Oakley Wood Landfill and a local groundwater abstraction.

13237

Dr Phillip Evans
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Philippa.fowler@sercoassurance.com

3 September 2004

Dear Phillip

Oakley Wood: Groundwater Sampling for List I Substances

We now have the results for the groundwater sampling for List I substances for all seven boreholes at Oakley Wood. The results are presented in Table 1.

Four boreholes were sampled in June 2004, and the three remaining boreholes in August 2004 due to access problems to the field to the north of the site road. The two batches of results would appear to differ in that Boreholes 5, 6, 10 and 15 are characterised by higher nitrates and chloride concentrations and lower SVOCs and VOCs compared to Boreholes 1, 13, and 14.

I have investigated whether this is a potential dilution problem by looking at the long term chloride concentrations, and I have attached a graph of the trends. These show that the both sets of chloride concentrations are consistent with their long-term trends. Comparison of the recent nitrate concentrations with Total Oxidised Nitrogen, last monitored in 2000, show that Boreholes 5, 10 and 15 would expect to have higher nitrate concentrations. Therefore it is concluded that dilution is not influencing the difference between the sample batches. It has not been possible to determine the effect of denitrification of ammonium from the data, since the ammonium concentration is at the limit of detection.

The SVOCs show a difference in the sampling batches with trace concentrations of Napthalene and 2- Methylnaphthalene in Boreholes 5, 6, 10 and 15, but none in Boreholes 1, 13 and 14. Three VOCs are present in the in Boreholes 5, 6, 10 and 15 and these are Trichlorofluoromethane, Trichloroethene and Tetrachloroethene. The later two VOCs are similar in concentration to previous concentrations.

Seven VOCs were detected in the groundwaters from in Boreholes 1, 13 and 14. Both Dichlorodifluoromethane and Trichlorofluoromethane were detected at concentrations between 21 and 115 ug/l. They are both used as refrigerants and propellants and have not

previous been routinely detected at Oakley Wood. 1.1.1–Trichloroethane (3 – 13 ug/l) is similar in concentration to those previously recorded. One of its breakdown products, 1.1-Dichloroethane, has also been detected at concentrations between 9 and 20 ug/l. Tetrachloroethene showed a concentration of 22 ug/l compared to a previous peak of 5 ug/l, while Trichloroethene is similar in concentration to historical values. Trace concentrations of Toluene were also detected.

These differences in the concentrations of SVOCs and VOCs are considered to be due to location rather to temporal changes between samples. Boreholes 5, 6, 10 and 15 are located down-gradient of the Original Fill, which was reported to contain a high proportion of inert wastes from demolition, while Boreholes 1, 13 and 14 are down-gradient of Cells 0 and 1 with more domestic and commercial wastes.

The presence of Trichlorofluoromethane now suggests a hydraulic link with Coldharbour Farm since in May 2000 Serco Assurance detected 4 ug/l of Trichlorofluoromethane in the borehole water there.

From a search on the internet chlorofluoromethanes would appear to be not uncommon constituents of landfill leachate, but in the UK we have no specific water quality standards against which to assess the risk from these substances. Serco Assurance recommends that you forward these results to Craig Hampton of the Environment Agency who may have access to further information to assist in the determination as to whether this site will be classed as a Special Site with respect to contaminated land.

If you have any queries, then do not hesitate to contact me.

Yours sincerely,

Philippa Towler

Dr Philippa Towler C.Geol, MCIWEM, MCIWM

Table1: Analytical results of List I Groundwater Sampling at Oakley Wood, June/August 2004

	Date Sampled	13-Jun-04	13-Jun-04	13-Jun-04	13-Jun-04	02-Aug-04	02-Aug-04	02-Aug-04		
Determinand	**Units**	**BH5**	**BH6**	**BH10**	**BH15**	**BH1**	**BH13**	**BH14**	**DWS**	**DWS comment**
Nitrate	mg/l	47.2	33.9	84.4	57.2	28.7	34.5	29.2	50	
Chloride	mg/l	42	23	57	29	29	17	17	250	
Ammonium	mg/l	<0.2	0.2	0.2	<0.2	<0.2	<0.2	<0.2	0.5	
Naphthalene	ug/l	7	6	6	6	1	1	<1		
2-Methylnaphthalene	ug/l	4	4	4	4	<1	<1	<1		
Dichlorodifluoromethane	ug/l	<1	<1	<1	<1	115	24	23		
Trichlorofluoromethane	ug/l	11	19	15	8	43	35	21		
1.1 - Dichloroethane	ug/l	<1	<1	<1	<1	20	12	9		
1.1.1 - Trichloroethane	ug/l	<1	<1	<1	<1	3	13	6		
Trichloroethene	ug/l	1	4	2	2	5	8	5	}	
Tetrachloroethene	ug/l	4	8	3	3	4	22	9	}10	parametric value applies to the sum of the concentrations of the indiviual compounds
Toluene	ug/l	<1	<1	<1	<1	2	1	<1		