Environmental, economic and social impacts of the use of sewage sludge on land

Consultation Report on Options and Impacts

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ENVIRONMENTAL LAW & POLICY

WRc

RPA

This report has been prepared by RPA, Milieu Ltd and WRc for the European Commission, DG Environment under Study Contract DG ENV.G.4/ETU/2008/0076r. The primary author was Ms Rocio Salado. Additional expertise was provided by Elizabeth Daly, Daniel Vencovsky, Tony Zamparutti and Rod Palfrey. The views expressed herein are those of the consultants alone and do not necessarily represent the official views of the European Commission.

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Executive Summary

Introduction

Milieu Ltd, together with partners WRc and Risk & Policy Analysts Ltd (RPA), is working on a contract for the European Commission's DG Environment, entitled *Study on the environmental, economic and social impacts of the use of sewage sludge on land* (DG ENV.G.4/ETU/2008/0076r).

The Sewage Sludge Directive (86/278/EEC) could be said to have stood the test of time in that sludge recycling has expanded since its adoption without environmental problems. Since its adoption, however, several Member States have put in place stricter national requirements. Moreover, EC legislation has evolved in many related fields, such as chemicals regulation. Any revision should aim to retain the flexibility of the original Directive which has permitted sludge recycling to operate effectively across the wide range of agricultural and other environmental conditions found within the expanded EU.

The aim of the study is to provide the Commission with the necessary elements for assessing the environmental, economic and social impacts, including health impacts, of present practices of sewage sludge use on land, provide an overview of prospective risks and opportunities and identify policy options related to the use of sewage sludge on land. This could lay the basis for the possible revision of Community legislation in this field.

This is the fourth deliverable of the study: the first was a review of literature on the topic, *Assessment of existing knowledge*. The second was the development of a baseline scenario to 2020 concerning the spreading of sewage sludge on land and an analysis of the relevant risks and opportunities. The third was the development of the options.

This report provides the initial list of Options for the revision of Directive 86/278/EEC as well as a preliminary assessment of the Options, including a preliminary cost-benefit analysis (CBA). Reviewers are encouraged to comment on this report. In particular, the report is interspersed with several questions and requests for additional information: responses with useful data would help strengthen the final assessment.

The Options

An initial set of five options for the revision of the Sewage Sludge Directive (Directive 86/278/EEC) was developed based on the review of literature and of regulations in Member States as well as comments received from Member States and stakeholders in the first consultation for this study and the first workshop. The options are as follows:

Option 1: do-nothing: keeping the Directive as it is;
Option 2: introduce certain more stringent standards, especially for heavy metals, standards for some organics and pathogens, and more stringent requirements on the application, sampling and monitoring of sludge;
Option 3: introduce more stringent standards across all substances and bans on application of sludge to some crops;
Option 4: total ban on the use of sludge on land; and
Option 5: repeal of the Directive.

The Options were agreed with the Commission, bearing in mind the findings of the first consultation and the communication from the Commission in 2003. The specific components of the Options are detailed in Section 1 of this report (see in particular

Table 3: Option comparison by **component**).

Comparison of the Options

An impact screening of the different options was one of the first steps of the assessment, following the EC Impact Assessment Guidelines. The most important impacts identified in this screening have been carried forward for detailed assessment. The following Table sets out the results of this first assessment of the Options in qualitative terms. (Section 1 of this report provides further information, including an overview of the methodology, which is described in greater detail in Annex 2.)

Table 1: Initial qualitative assessment

Option	Economic Impacts	Environmental Impacts	Social Impacts
Option 1 - Baseline Scenario	0	0	0
Option 2 – "moderate changes"	Costs of alternative disposal (-) Obligation of treatment (-) Pollution prevention costs (?) Policy implementation and control Changes to regulation: including costs of consultation (-) Pollution prevention costs Benefits if meeting other related legislation requirements (i.e. WFD) (+) Loss of use of sludge as a fertiliser and fertiliser replacement costs (-) Loss of agr. output/crops (?)	Environmental benefits from reduced application (?/+) Environmental benefits/costs from alternative routes of disposal including climate change impacts from incineration, landfilling (?/-)	Human health benefits from reduced application (?/+) Human health costs from alternative routes of disposal, e.g. air pollution from incineration (?/-)
Option 3 – more significant changes	As above but greater in magnitude		
Option 4 - Total Ban	Fertiliser replacement costs (--) Alternative routes of disposal for all sludge arisings (--) Loss of agricultural output/crops (-/?)	Environmental benefits from reduced application (?/+) Environmental benefits/costs from alternative routes of disposal including climate change impacts (--)	Human health benefits from reduced application (?/+) Human health from alternative routes of disposal including climate change impacts (--) Amenity impacts from increased landfilling (--)
Option 5 - Repeal of the Directive	Benefits from reduced policy monitoring and compliance (+)	Environmental benefits/costs from alternative routes of disposal including climate change (?) Potential environmental risks if a MS abandons all sludge regulation (?/--)	Human health from alternative routes of disposal including climate change (?) Potential risks to human health if a MS abandons all sludge regulation (?/--) Amenity impacts from increased landfilling (?)

0: impact expected to be negligible;
- : low/moderate negative impacts expected
--: significant negative impacts expected
+: low/moderate positive impacts
++: significant impacts expected

Option 1 is the baseline: the costs and benefits of the other options are assessed in comparison with this one. Option 2 is unlikely to have significant economic cost implications. Option 3 is likely to affect a significant number of sewage treatment plants. The greatest economic costs are expected from Option 4, the total ban.

Options 2, 3 and 4 will reduce potential environmental and health impacts from spreading sewage sludge to land, but increase impacts from alternative disposal paths. While some of these impacts – e.g. climate change and air pollution impacts from greater incineration – can be assessed, this is not true for all. In particular, Options 2, 3 and 4 will reduce environmental and health impacts from spreading sludge on land. Here, the project team has not found literature quantifying this reduction in the information gathered for the study, including the responses to the first consultation. Much of the literature and many responses to the first consultation indicate that the current levels (Option 1) adequately protect environment and human health. However, some Member States have introduced more stringent requirements for precautionary reasons. Moreover, some respondents to the consultation oppose the application of sewage sludge to land for precautionary reasons. It is important to recognise that the potential environmental and health benefits resulting from more stringent sludge standards in Options 2 and 3 (as well as the total ban in Option 4) are not quantified here, nor will be in the final CBA unless respondents can provide relevant data.

For Option 5, the impacts are highly uncertain, and in particular the environmental and health impacts are potentially high. In a preliminary analysis, it appears that Option 5 is not acceptable on the basis of the precautionary principle: on the basis of this conclusion, and also considering the great uncertainty of the impacts, a cost-benefit analysis has not been undertaken for this option.

This draft presents a preliminary cost-benefit analysis (CBA). The following Table summarises the costs for each option, as calculated under this preliminary CBA. (A detailed discussion of the assumptions used in the CBA are provided in Sections 2 through 6, which discuss each Option in turn.)

Table 2: Summary - Initial quantitative assessment (€ million)

	Economic costs		**Environmental/Human health costs**
	Low	**High**	
Present Value costs			
Option 1 – Baseline (no change)	n/a		
Option 2 – Moderate changes	2,470	2,940	243
Option 3 – More significant	5,660	6,860	576
Option 4 – Total ban	7,100	9,400	1,369
Option 5 – Repeal of Directive	Not estimated		
Annualised costs			
Option 1 – Baseline (no change)	n/a		
Option 2 – Moderate changes	295	352	29
Option 3 – More significant	677	821	69
Option 4 – Total ban	849	1,124	164

Option 5 – Repeal of Directive	Not estimated

It should be underlined, as noted above, that the estimates do not include all impacts, and in particular do not include potential benefits to the environment and human health related to stricter standards for the application of sludge to land in options 2 and 3 (nor the related benefits from the total ban in option 4). And, as noted above, the impacts here are highly uncertain. The environmental and human health costs do however include estimates of the costs related to emissions from alternative routes of disposal and transport impacts.

There may be additional benefits from certain options in terms of amenity and public perception. These are highly uncertain, however. One other benefit from Options 2, 3 and 4 is that in some areas they could help meeting some other legislation objectives, such as objectives for the Water Framework Directive. These benefits have not been quantified, as it will depend on the degree of implementation of the different legislation at national level and information on this is limited.

This draft for consultation provides an initial assessment of the impacts of different options. On the basis of the results of this open, web-based consultation, together with a workshop to be organised by the European Commission in early 2010, the project team will revise this assessment for the project final report.

This report is presented as a draft for comments on the part of Member States, stakeholders and researchers in the second consultation for the study. For this reason, a number of questions are interspersed through the main sections of the report. These questions request further data as well as opinions and suggestions regarding individual topic areas.

While there are a number of questions, in general they ask for your inputs regarding the following three key areas:

- **How do you see the potential impacts of the Options or specific components of the Options, and in particular the impacts on your Member State, industry or field of expertise?**
- **What is the share of sludge currently recycled to land that will be affected by each Option?**
- **What unit costs/benefits do you foresee for the impacts under consideration? In particular, are the unit costs/benefits we detail in the report, including in Annex 2, reasonably accurate?**

Your feedback will be used in our final report, including our spreadsheet model to generate estimates of the total costs and benefits from the different options and option sub-components. Where we do not receive alternative estimates or new data, we will continue to use the estimates from the available literature presented in this draft.

Please feel free to send us any relevant documentation that you consider may help us in assessing the impacts of the proposals to e-mail address rocio.salado@rpaltd.co.uk or to the following postal address:

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1 Introduction

1.1 Overview of Options

An initial set of options for the revision of the Sewage Sludge Directive was developed based on the review of literature and of regulations in Member States as well as comments received from Member States and stakeholders in the first consultation for this study and the first workshop.

The consultation on the previous report, the Interim Report[1], has revealed different opinions concerning changes to the Directive, with some member states (MS) favouring the status quo whilst others consider that changes to the Directive are required. The changes proposed included the following:

- Revision of current limit values for heavy metals;
- Introduction of limit values for organic pollutants;
- Introduction of pathogen concentration limits; and
- Introduction of a quality assurance system.

The project team developed a long list of options, which was reviewed with the European Commission. The original list included options which were deemed technically unfeasible or out of the scope of this study (for instance extending the boundary of the Directive to include uses such as reclamation, recreational and energy crops as the Directive is focused on agricultural land only). As a result, five options were developed. The options carried out for this IA have also considered the previous Commission Communication in 2003[2]. There are five options as follows:

Option 1: do-nothing: keeping the Directive as it is;
Option 2: introduce certain more stringent standards, especially for heavy metals, standards for some organics and pathogens, and more stringent requirements on the application, sampling and monitoring of sludge;
Option 3: introduce more stringent standards across all substances and bans on application of sludge to some crops;
Option 4: total ban on the use of sludge on land; and
Option 5: repeal of the Directive.

A detailed description of each option is provided in Table 3. This report presents these five options and the initial work for their impact assessment. The information presented here draws on the previous work of the project, including the development of a baseline scenario, with projections to 2020, assuming no change is made to the Sewage Sludge Directive.

The project final report will present a more detailed assessment, including a quantitative cost-benefit analysis (CBA). In order to undertake a reasonably robust quantitative analysis, however, additional data are required. For this reason, a series of questions and requests for additional data to Member States and stakeholders are presented in this report. These are also presented in order to verify our assumptions. The rest of the Section presents the methodology and the impact screening for the different Options.

[1] WRc, Milieu and RPA (2009): Environmental, economic and social impact of the use of sewage sludge on land, Interim Report, October 2009.

[2] CEC (2003): Proposal for a Directive of the European Parliament and the Council on spreading of sludge on land, Brussels, 30 April 2003.

Table 3: Option comparison by component

	Option 1 = Baseline Scenario	**Option 2 = Moderate changes (some standards more stringent)**		**Option 3 – More significant changes (more stringent standards)**		**Option 4 = Total Ban**	**Option 5 = Repeal of the Directive**
Limits on sewage sludge content							
Heavy metals	Retain existing limits (as given in Annex IB and IC)	More stringent standards		More stringent standards		Total ban	N/a
		PTE	mg/kg	PTE	mg/kg		
		Cd	10	Cd	5		
		Cr	1000	Cr	150		
		Cu	1000	Cu	400		
		Hg	10	Hg	5		
		Ni	300	Ni	50		
		Pb	750	Pb	250		
		Zn	2500	Zn	600		

	Option 1 = Baseline Scenario	Option 2 = Moderate changes (some standards more stringent)	Option 3 – More significant changes (more stringent standards)	Option 4 = Total Ban	Option 5 = Repeal of the Directive
Organics	No change – no limits	1-2 standards for "indicator" organics: PCB and PAH PAH 6mg/kg dry matter PCB 0.8 mg/kg dry matter	Introduce standards for organics for PAH, PCB, LAS, NPE, Dioxins, DEHP PAH3 6 mg/kg dry matter PCB4 0.8 mg/kg dry matter PCDD/F5 100 ng ITEQ/kg dry matter LAS6 5 g/kg dry matter NPE7 450 mg/kg dry matter	Total ban	
Pathogens	No change – no limits	Conventional treatment, i.e. any sludge treatment capable of achieving a reduction in Escherichia coli to less than 5x105 colony forming units per gram (wet weight) of treated sludge.	Advanced standard that sanitises sludge and achieves: a) a 99.99% reduction of Escherichia coli to less than 1·103 colony forming unit per gram (dry weight) of treated sludge; b) a 99.99% reduction in Salmonella Senftenberg W775 for sludge spiked with this micro-organism; c) no Ascaris ova; c) a sample of 1 gram (dry weight) of the treated sludge does not contain more than 3·103 spores of Clostridium perfringens; d) and a sample of 50 grams (wet weight) of the treated sludge does not contain Salmonella spp.	Total ban	

[3] Sum of the following polycyclic aromatic hydrocarbons: acenapthene, phenanthrene, fluorene, flouranthene, pyrene, benzo(b+j+k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, indeno(1, 2, 3-c, d)pyrene.

[4] Sum of the polychlorinated biphenyls components number 28, 52, 101, 118, 138, 153, 180.

[5] Polychlorinated dibenzodioxins/ dibenzofuranes.

[6] Linear alkylbenzene sulphonates.

[7] It comprises the substances nonylphenol and nonylphenolethoxylates with 1 or 2 ethoxy groups.

<table>
<tr><th></th><th>Option 1 = Baseline Scenario</th><th colspan="4">Option 2 = Moderate changes (some standards more stringent)</th><th colspan="4">Option 3 – More significant changes (more stringent standards)</th><th>Option 4 = Total Ban</th><th>Option 5 = Repeal of the Directive</th></tr>
<tr><td>Nutrients</td><td>No change – no limits</td><td colspan="4">NO standards but provision of information on N:P and C content.</td><td colspan="4">As in Option 2</td><td>Total ban</td><td rowspan="3"></td></tr>
<tr><td>Other changes concerning quality and aimed at prevention</td><td>No change</td><td colspan="4">Require stabilisation (or pseudostabilisation) to reduce methane emissions during storage and from land. A potential indicator is the lack of oxygen demand; use volatile solid (VS) reduction of 38% or specific oxygen uptake rate of less than 1.5mg/h/g total solids</td><td colspan="4">As in Option 2 and Hazard Assessment and Critical Control Points Assessment (HACCP)</td><td>Total ban</td></tr>
<tr><td colspan="11">More stringent conditions on application of treated sludge to land</td></tr>
<tr><td colspan="11">Soil composition</td><td rowspan="10">N/a</td></tr>
<tr><td rowspan="9">Heavy metals</td><td rowspan="9">No change</td><td colspan="4">Heavy metal concentration (mg/kg)</td><td colspan="4">Heavy metal concentration (mg/kg)</td><td rowspan="9">Total ban</td></tr>
<tr><td>PTE</td><td>5<pH<6</td><td>6<pH<7</td><td>pH>7</td><td>PTE</td><td>5<pH<6</td><td>6<pH<7</td><td>pH>7</td></tr>
<tr><td>Cd</td><td>0.5</td><td>1</td><td>1.5</td><td>Cd</td><td>0.5</td><td>1</td><td>1.5</td></tr>
<tr><td>Cr</td><td>50</td><td>75</td><td>100</td><td>Cr</td><td>50</td><td>75</td><td>100</td></tr>
<tr><td>Cu</td><td>30</td><td>50</td><td>100</td><td>Cu</td><td>30</td><td>50</td><td>100</td></tr>
<tr><td>Hg</td><td>0.1</td><td>0.5</td><td>1</td><td>Hg</td><td>0.1</td><td>0.5</td><td>1</td></tr>
<tr><td>Ni</td><td>30</td><td>50</td><td>70</td><td>Ni</td><td>30</td><td>50</td><td>70</td></tr>
<tr><td>Pb</td><td>70</td><td>70</td><td>100</td><td>Pb</td><td>70</td><td>70</td><td>100</td></tr>
<tr><td>Zn</td><td>100</td><td>150</td><td>200</td><td>Zn</td><td>20</td><td>20</td><td>200</td></tr>
<tr><td>Organics</td><td>No change</td><td colspan="4">No limits , i.e. no change</td><td colspan="4">No limits, i.e. no change</td><td>Total ban</td></tr>
<tr><td>Pathogens</td><td>No change</td><td colspan="4">No limits, i.e. no change</td><td colspan="4">No limits, i.e. no change</td><td>Total ban</td></tr>
<tr><td>Nutrients</td><td>No change</td><td colspan="4">Information only</td><td colspan="4">Nitrate vulnerable zones</td><td>Total ban</td></tr>
<tr><td>Conditions on application</td><td>No change</td><td colspan="4">Setting periods for harvesting for grassland and/or forage crops– Article 7.a
Make compulsory 10 month period for fruit, vegetable crops
Ban the application of untreated sludge – changes to Article 6 which currently allows MS to authorise under certain conditions the use of untreated sludge if injected or worked into the soil. Outright ban on the use of untreated sludge injected or worked into the soil – changes to Article 6
Liquid sludge may only be used if injected or immediately worked into soil.</td><td colspan="4">Ban of application of sludge for fruit, vegetable crops and grassland</td><td>Total ban</td></tr>
</table>

<table>
<tr><th></th><th>Option 1 = Baseline Scenario</th><th colspan="6">Option 2 = Moderate changes (some standards more stringent)</th><th>Option 3 – More significant changes (more stringent standards)</th><th>Option 4 = Total Ban</th><th>Option 5 = Repeal of the Directive</th></tr>
<tr><td rowspan="10">Other changes, i.e. sampling and monitoring, Quality assurance scheme</td><td rowspan="10"></td><td rowspan="2">Quantity of sludge (tDM/year /plant)</td><td colspan="5">Minimum number of analyses per year</td><td rowspan="10">As in Option 2 but Option 3 could have more substances to be tested (organics)</td><td rowspan="10">Total ban</td><td rowspan="10"></td></tr>
<tr><td>Agronomic para-meters</td><td>Heavy metals</td><td>OCs (except dioxins)</td><td>Diox-ins</td><td>Micro-organ-isms</td></tr>
<tr><td>< 50</td><td>1</td><td>1</td><td>-</td><td>-</td><td>1</td></tr>
<tr><td>50 – 250</td><td>2</td><td>2</td><td>-</td><td>-</td><td>2</td></tr>
<tr><td>250 – 1000</td><td>4</td><td>4</td><td>1</td><td>-</td><td>4</td></tr>
<tr><td>1000 – 2500</td><td>4</td><td>4</td><td>2</td><td>1</td><td>4</td></tr>
<tr><td>2500 – 5000</td><td>8</td><td>8</td><td>4</td><td>1</td><td>8</td></tr>
<tr><td>> 5000</td><td>12</td><td>12</td><td>6</td><td>2</td><td>12</td></tr>
<tr><td colspan="6">Ease the sampling and reporting requirements in case of QAS for separate discussion. Should be available for both option 2 and 3. Include CEN TC 308 procedures.</td></tr>
</table>

1.2 Impact Screening

Table 4 shows the impact screening based on the IA Guidelines by the Commission for the different Options. When impacts are uncertain, they have been carried forward for the analysis. The greatest uncertainty applies to Option 5 as this will finally rely on principles of subsidiarity and national legislation and implementation at MS level.

Table 4: Impact Screening

	Option 1 - BAU	**Option 2 - moderate changes**	**Option 3 - more significant changes**	**Option 4 - ban on the use of sludge on land**	**Option 5 - Repeal of the Directive**
	Impacts likely?				
ECONOMIC IMPACTS					
Functioning of the internal market and competition	No	Uncertain	Uncertain	Yes	Uncertain
Competitiveness, trade and investment flows	No	Uncertain	Yes	Yes	Uncertain
Operating costs and conduct of SMEs	No	Yes	Yes	Yes	Uncertain
Administrative burdens on business	No	Yes	Yes	Uncertain	Uncertain
Public authorities	No	Yes	Yes	Yes	Uncertain
Property rights	No	No	No	Uncertain	Uncertain
Innovation and research	No	Uncertain	Uncertain	Yes	Uncertain
Consumers and household	No	Uncertain	Uncertain	Yes	Uncertain
Specific regions and sectors	No	Yes	Yes	Yes	Uncertain
Third countries and international relation	No	No	No	Uncertain	Uncertain
Macroeconomic environment	No	Uncertain	Uncertain	Uncertain	Uncertain
SOCIAL IMPACTS					
Employment and Labour markets	No	Uncertain	Uncertain	Yes	Uncertain
Standards and rights related to job quality	No	No	No	No	No
Social inclusion and protection of particular groups	No	No	No	No	No
Gender equality, non-discrimination	No	No	No	No	No
Governance, participation	No	No	No	Uncertain	Uncertain
Public health and safety	No	Yes	Yes	Yes	Uncertain
Crime, terrorism and security	No	No	No	No	No
Access to social protection and health	No	No	No	No	No
Culture	No	No	No	No	No
Impacts on third countries	No	No	No	No	Uncertain
ENVIRONMENTAL IMPACTS					
The climate	No	Yes	Yes	Yes	Uncertain
Transport and the use of energy	No	Yes	Yes	Yes	Uncertain
Air quality	No	Yes	Yes	Yes	Uncertain
Biodiversity, flora, fauna and landscape	No	Uncertain	Uncertain	Yes	Uncertain
Water quality and resources	No	Uncertain	Uncertain	Uncertain	Uncertain
Soil quality and resources	No	Uncertain	Uncertain	Uncertain	Uncertain
Land use	No	Uncertain	Uncertain	Yes	Uncertain
Renewable and non-renewable sources	No	Yes	Yes	Yes	Uncertain
Environmental consequences	No	Uncertain	Uncertain	Uncertain	Uncertain
Waste production/generation/recycling	No	Yes	Yes	Yes	Uncertain
Likelihood of environmental risk	No	Uncertain	Uncertain	Uncertain	Uncertain
Animal welfare	No	No	No	No	Uncertain
International and environmental impacts	No	Uncertain	Uncertain	Uncertain	Uncertain

The range of stakeholders affected and types of costs and benefits considered are set out in Table 5.

Table 5: Stakeholders and costs/benefits

Stakeholder	**Economic impacts**	**Environmental Impacts**	**Social Impacts**
Water and sludge management operators	Costs of alternative disposal Quality assurance – including reporting requirements Obligation of treatment Pollution prevention costs *Distributional impacts	Environmental benefits/costs from changes in risk of application and alternative routes of disposal including climate change	Amenity (odour) Reduction/increase in risk – human health Employment impacts
Regulatory authorities	Policy implementation and control Changes to regulation –including costs of consultation Pollution prevention costs Benefits if meeting other related legislation requirements (i.e. WFD) *Distributional impacts		
Farmers	Loss of use of sludge as a fertiliser and fertiliser replacement costs Loss of agricultural output/crops Amenity (uplift in value of land from reduced sludge application)		
Consumers/Public	Increased bills		
Food/retailers	Increased sales from reduced sludge –linked to consumer demands		
Fertiliser manufacturers	Increased sales from fertiliser replacement		
*: Distributional impacts are assessed separately under this IA based on total cost /benefit estimation. However, they come under the economic impact category in the Impact Assessment. We have included them separately in order to incorporate environmental and social costs and benefits.			

Based on the option description and the impact screening the most important impacts carried forward are set out in Table 6 below. The Table also provides an initial qualitative assessment of the impacts. The impacts and the approach to their assessment are described Annex 2.

Table 6: Initial qualitative assessment

Option	Economic Impacts	Environmental Impacts	Social Impacts
Option 1 - Baseline Scenario	None (baseline option)	None (baseline option)	None (baseline option)
Option 2 – "moderate changes"	Costs of alternative disposal (-) Obligation of treatment (-) Pollution prevention costs (?) Policy implementation and control Changes to regulation –including costs of consultation (-) Pollution prevention costs Benefits if meeting other related legislation requirements (i.e. WFD) (+) Loss of use of sludge as a fertiliser and fertiliser replacement costs (-) Loss of agricultural output/crops (?)	Environmental benefits/costs from alternative routes of disposal including climate change impacts from incineration, landfilling (?/-)	Human health from alternative routes of disposal (?/-), e.g. air pollution from incineration (?/-)
Option 3 – more significant changes	As above but greater in magnitude		
Option 4 - Total Ban	Fertiliser replacement costs (--) Alternative routes of disposal for all sludge arisings (--) Loss of agricultural output/crops (-/?)	Environmental benefits/costs from alternative routes of disposal including climate change impacts (--)	Human health from alternative routes of disposal including climate change impacts (--) Amenity impacts from increased landfilling (--)
Option 5 - Repeal of the Directive	Benefits from reduced policy monitoring and compliance (+)	Environmental benefits/costs from alternative routes of disposal including climate change (?) Potential environmental risks if a MS abandons all sludge regulation (?/--)	Human health from alternative routes of disposal including climate change (?) Potential health risks if a MS abandons all sludge regulation (?/--) Amenity impacts from increased landfilling (?)
0: impact expected to be negligible; - : low/moderate negative impacts expected --: significant negative impacts expected +: low/moderate positive impacts ++: significant impacts expected			

Questions for the consultation

Q 1: Do you have any comments on the Options as proposed, in particular in terms of their expected impacts?

1.3 Overview of Methodology

For all options, the approach will be the following:

- Step 1: Description of the options and option components;
- Step 2: Impact assessment, with:
    - Step 2.1: Identification of MS affected by changes to the Directive, due to current national legislation and current practices;
    - Step 2.2: Direct impact estimation when impacts are considered likely (quantification, when feasible, of sludge failing or percent of agricultural land affected), recycling rates and changes in amount going to different disposal options; and
    - Step 2.3: Indirect impacts from changes in the above in terms of costs and benefits to the different stakeholders (e.g. fertiliser replacement, costs of incineration, etc). The approach will then be the following:

Costs/Benefits = amount of sludge affected x impact (in quantitative term) x unit costs (€) for impact

The assessment of options follows a similar approach to the CBA conducted in 2002 (by Sede and Andersen; although there will be differences as some of these limits proposed in the options here are slightly different from those in the 2003 Communication analysed in that study). A comparison of limits proposed in this study, the 2002 report and the limits under the current baseline is given in Annex 1.

This Impact Assessment (IA) aims to quantify all the impacts where data are available that allow initial estimates to be made of the costs and benefits. Where impacts have not been quantified due to a lack of data, these are described qualitatively. When impacts are highly uncertain, ranges have been used or qualitative descriptions used. Such descriptions will be refined upon receiving your comments and data in order to improve the assessment, making it more robust and reducing uncertainty. Table 7 presents a summary of the impacts that have been quantified in this IA.

Table 7: Impact quantification

	Quantified	Comments
Economic impacts		
Costs of alternative disposal	Yes	Source: Andersen and Sede (2002), updated to 2009 values
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Yes	
Pollution prevention costs	Yes	
Obligation of treatment	Yes	
Quality assurance – including reporting requirements	Yes	
Loss of agricultural production	No	Difficult to estimate with accuracy and uncertain– will depend on total costs and feedback from stakeholders required
Employment impacts	No	Difficult to estimate with accuracy – will depend on total costs and feedback from stakeholders required
Amenity (increase in real or perceived value of land from reduced sludge application)	No	Highly uncertain, hence not estimated
Energy recovery	No	It may be possible to make an estimate in the next stage of the impact assessment
Impact on markets for mineral and other natural fertilizers	No	The impacts are considered low, as the fertilizer market is much larger in volume than sludge market

		(but impact might be greater under Option 4); local impacts are possible, however
Increased bills	No	Depend on national practices – not enough data to estimate with accuracy - feedback from stakeholders required
Increased sales from reduced sludge – linked to consumer demands	No	Highly uncertain, hence not estimated
Innovation and research	No	Highly uncertain, hence not estimated
Environmental impacts		
Environmental benefits/costs from changes in risk from changes in quantity of recycled sludge: e.g. soil impacts, discharges to surface water and groundwater	No	Not enough evidence of impacts from sludge application – excluded from quantification. Environmental impacts from transport included though
Environmental benefits/costs from changes in risk from alternative disposal: • CO_2 emissions and impact on climate change • Other air pollutants • Discharges to water and groundwater	Partially	Linked to emissions, energy recovery and transport Information is currently available to quantify some of these impacts (e.g. CO_2 emissions), and the results have been included in the CBA In the next stage of the impact assessment, further work could quantify certain impacts (especially if new data are available) by major area
Social		
Amenity (odour)	No	Highly uncertain and variable among MS
Human health impacts from changes in risk from changes in quantities of recycled sludge	No	Not enough evidence of impacts from sludge application – excluded from quantification. Human health impacts from transport included though
Human health benefits/costs from changes in risk from alternative disposal • Air emissions from incineration in particular	Yes	Linked to emissions, energy recovery and transport. Included in environmental values
Benefits if meeting other related legislation requirements (i.e. WFD)	No	Difficult to quantify. Significant data requirements on degree of implementation of relevant policies
Consumer confidence	No	Highly uncertain and variable among MS.

A detailed discussion of the approach to the assessment of the different impacts where quantification is possible can be found in:

Annex 2: Approach to the Assessment of different IMPACTS.

As noted previously, the project team is seeking additional data from Member States and stakeholders in order to ensure a robust analysis. In particular, the answers to our data requests will help to establish the amount of sludge affected by different options and failing to comply, the amount of land affected and stopped from production and the costs of treatment and fertiliser. Throughout the text you will find a series of detailed questions aimed at gathering these types of data.

The period for analysis is the same as that used in the Interim report: to 2020. The benefits and costs have been discounted at 6%. The cost values, where taken from Sede and Anderson, 2002, have been updated using the Retail Price Index.

2 Option 1: Do-nothing

2.1 Overview of Option

This Option will be the business as usual scenario. Under this Option, the amount of sludge produced and recycled will depend on national legislation and practices. The amount of sludge producted and recycled was estimated in our previous report and is replicated here for analytical purposes. This will be the baseline for estimating the amount of recycled sludge affected, together with the interpolated figures projected until 2020, under the different Options.

Table 8: Recent sewage sludge production and quantities recycled to agriculture in the 27 EU Member States (Doujak 2007, EC, 2006, EC, personal communication, 2009, IRGT 2005, Eurostat 2007(as reported by France-need to check), DSD/DPS 2009, personal communication)

Member State	**Year**	**Sludge production**	**Agriculture**	
		(t DS)	**(t DS)**	**(%)**
Austria (a)	2005	266,100	47,190	18
Belgium				
• Brussels region (b)	2006	2,967	0	0
• Flemish region	2006	101,913	0	0
• Walloon region ©	2007	31,380	10,927	35
Denmark	2002	140,021	82,029	59
Finland (d)	2005	147,000	4,200	3
France	2007	1,125,000	787,500	70
Germany (e)	2007	2,056,486	592,552	29
Greece	2006	125,977	56.4	0
Ireland	2003	42,147	26,743	63
Italy	2006	1,070,080	189,554	18
Luxembourg	2003	7,750	3,300	43
Netherlands	2003	550,000	34	<0
Portugal	2002	408,710	189,758	46
Spain	2006	1,064,972	687,037	65
Sweden (f)	2006	210,000	30,000	14
United Kingdom	2006	1,544,919	1,050,526	68
Sub-total EU 15		***8,895,422***	***3,701,406***	***42***
Bulgaria	2006	29,987	11,856	40
Cyprus	2006	7,586	3,116	41
Czech republic	2007	231,000	59,983	26
Estonia (g)	2005	Nd	3,316	?
Hungary (h)	2006	128,380	32,813	26
Latvia	2006	23,942	8,936	37
Lithuania (i)	2007	76,450	24,716	32
Malta (j)		Nd	Nd	nd
Poland	2006	523,674	88,501	17
Romania	2006	137,145	0	0
Slovakia	2006	54,780	0	0
Slovenia	2007	21,139	18	0
Sub-total for EU 12		***1,234,083***	***233,255***	***19***
Total		**10,129,505**	**3,934,661**	**39**

Notes:

a) Austria has not submitted figures to the Commission for the last two surveys. Figures presented above are from Doujak (2007) from UBA: total sludge production amounts to 420,000 t DM in 2005. This includes 238,100 t DM municipal sewage sludge + 28,000 t DM exported and 155,000 t DM of industrial sludge (mainly from cellulose and paper industry).
b) In the Brussels Region, there are now 2 STEs; the Southern STW started operating in 2000 for 360,000 pe and the Northern STW was commissioned for 1.1 M pe and started operating in 2008. In 2002, sludge production in the Brussels Region was reported to amount to around 2800 t DM.; 66% was incinerated, 32% recycled to agriculture and 2% was sent to landfill (IGRT 2005). In 2006, there was no longer any recycling to agriculture and 1,720 tds were incinerated and 1,247 tds were landfilled (BRC 2009, personnel communication).
c) In addition, a large quantity of industrial sludge (food, breweries, paper, drinking water production, etc.) is also recycled to agriculture. In 2007, it amounted to 48,000 tds.
d) Proportion of sludge recycling to agriculture was substantially higher in the past, reaching 33% in 1995 and 17% in 2003.
e) Including 80% from urban sources and 20% from industrial sources.
f) No figures reported for total sludge production.
g) Estimates. No data for Estonia (taken average for Latvia and Lithuania)
h) Sludge production in Hungary increased steadily (120,741 tds in 2004, 125,143 tds in 2005) while the proportion being recycled to agriculture has decreased (30% in 2004 and 34% in 2005).
i) Sludge production increased steadily over the last few years from 55,349 tds in 2004, 65,679 tds in 2005 and 71,252 tds in 2006.
j) No data for Malta, assumed zero

There may be a risk with some of the newer MS who may introduce limits complying with the Directive but not conservative enough to reduce the risk to the extent now considered desirable by many consumers as well as regulatory bodies. These could give rise to greater environmental and human health risks than those present in other EU member states.

2.2 Assessment of the option

2.2.1 Economic Impacts

Option 1 will have limited impacts on the MS as it will not involve any changes to the Directive.

The impacts of the existing legislation however need to be taken into account when describing the baseline. The results of previous consultation show that respondents expect only limited effects on the amount of sludge recycled onto agricultural land by some regulation. For the REACH regulations, although there is an expectation that metals and organic contaminants are likely to reduce, some believe that the effect would be insufficient to achieve the level of purity they would find acceptable. Existing local restrictions have already driven the rate of agricultural recycling and there is no expectation of further significant changes based on sludge quality being driven by other regulations.

The most significant other drivers identified by respondents are the amounts of sludge being produced as sewerage collection systems are developed, increased rates of sludge production due to more stringent sewage effluent quality consents, and reduction in the availability of landfill disposal for sewage sludge. The WFD may affect the location and frequency of return to available land but this has not been identified as a significantly increased cost.

The following Table (based on consultation) shows the predicted increase in sludge production from 2010 to 2020. As can be seen, the majority of the increase is due to the newer MS.

Table 9: Future forecasted (2010 and 2020) sludge arisings in the EU27

Member State	**2010 (x10^3 tds pa)**	**2020 (x10^{3}tds pa)**
Austria	270	280
Belgium	166	166
Denmark	140	140
Finland	155	155
France	1,300	1,600
Germany	2,060	2,060
Greece	290	290
Ireland	135	135
Italy	1,500	1,500
Luxembourg	15	15
Netherlands	560	560
Portugal	420	420
Spain	1,280	1,280
Sweden	250	250
United Kingdom	1640	1,640
EU15	***10,181***	***10,491***
Bulgaria	30	180
Cyprus	9.8	17.6
Czech Republic	260	260
Estonia	33	33
Hungary	130	250
Latvia	25	50
Lithuania	80	80
Malta	10	10
Poland	520	950
Romania	165	520
Slovakia	55	135
Slovenia	20	50
EU12	***1,338***	***2,485***
EU27	**11,519**	**12,977**

Notes: As working estimates 2010 production rates have been taken to be the same as 2020 production for states expected to be in full compliance in 2010. For non-compliant states rounded 2006 production rates have been used – see text in Annex 2 for detail.
The estimate for Belgium includes 110,000 tds for the Flemish region; 50,500 tds for the Walloon Region and 5,000 tds for the Brussels region.

2.2.2 Environmental Impacts

Few respondents from the first consultation considered that the risks to be associated with PTE and OCs in sludge outweighed the benefits from nutrients and soil conditioning that could be achieved by using suitable and treated sludge.

Although the 2003 communication highlighted the risk that the Directive was not conservative enough to take into account the long-term accumulation of metals to the topsoil, as for the time of writing, there is no scientific evidence (as distinct from news stories) was identified that describes adverse effects when the conditions of the Directive have been met. However, this could be due to the fact that many MS have adopted more stringent standards than those given in the Directive (indeed most MS including Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Malta, Netherlands, Poland, Romania, Slovakia, Slovenia, and Sweden have limit values for metal concentrations more stringent than the lowest limits set in the 1986 Directive and some MS have additional standards for pathogens, metals and organics).

2.2.3 Social Impacts

Both the recent consultation and EC's Communication in 2003 regarding possible changes to the provisions of the Directive have highlighted the fact that the Directive had proven quite effective in preventing the spread of pathogenic micro-organisms to crops and outbreaks of epidemics in humans, in reducing the amount of heavy metals brought to the soil when using sewage sludge as well as in harmonising the pieces of national legislation existing before 1986 (CEC, 2003[8]).

While no evidence of health risks related to the current directive has been found, we also note that this may be influenced by the more stringent standards set by some Member States. Moreover, some respondents to the first consultation strongly opposed the application of sewage sludge to land for precautionary reasons.

In these circumstances, it is not possible to quantify any health impacts for the Baseline Scenario, nor the results of more stringent standards in the other options.

[8] CEC(2003): Proposals for a Directive of the European Parliament and of the Council on spreading of sludge on land, Brussels, 30 April 2003.

3 Option 2: changing standards (moderate change)

3.1 Overview

This Section sets out various questions to assess the impacts from the different components within Option 2. The Option will consist of the following:

- Changes to the limits on heavy metals concerning the quality of the sludge (as given in the CEC (2003)) and in soil;
- Setting limits for PCBs and PAHs for sludge quality;
- Introduce standards for treatment compatible with CEC (2003) conventional treatment;
- Provision of information on nutrients;
- More stringent conditions on application; and
- Small changes to sampling and monitoring requirements.

The main issue associated with this Option relates to the limitations on sludge use by restrictions that require higher standards in areas where there is no added value in terms of human health and the environment.

This Option is expected to impact the availability of sludge for application (percent of sludge produced that is failing the standards). This is likely to have economic, environmental and human health implications. Economic impacts will stem primarily from further treatment and the internal costs of alternative disposal options. The environmental and human health impacts will be related to the impact from the alternative routes of disposal.

Questions for the consultation

Q 2 – Would your MS be affected by any of the above components? You can move to the sections below that are relevant. If you believe that Option 2 will not impact you in any way, please state it here and move to Option 3 and/or any of the remaining options.

You can also check the summary of our assessment on Option 2(Summary of Costs and Benefits and Distributional Impacts from Option 2)

3.2 Assessment of Option by component

3.2.1 Changing limits for heavy metal content in sludge

No respondent to the first consultation offered clear proposed concentration values for limits to be set in any revised directive, other than by referring to the currently used values in individual Member States, and proposing that the Directive values should either be stricter, or relaxed for some of the metals. As a result, the limits proposed under Option 2 are based on those proposed in CEC (2003) and shown in Table 10.

As noted earlier, most MS have set more stringent standards than those in the current Directive. The current MS regulatory standards for heavy metals are given in Table 11. The Table sets out which MS may be affected by the limit on heavy metals under Option 2. Shaded in grey are the national limits that would have to be tightened. These MS will have to amend their national legislation so this will have some costs implications.

Table 10: Proposed limit values on Potentially Toxic Elements (PTE) in sewage sludge

PTE	CEC 2003 (mg/kg)
Cd	10
Cr	1000
Cu	1000
Hg	10
Ni	300
Pb	750
Zn	2500

Table 11: Countries with national limits less stringent than those proposed under Option 2 e.i. setting limits on Maximum level of heavy metals (mg per kg of dry substance) - in grey

PTE	Cd	Cr	Cu	Hg	Ni	Pb	Zn
New limits	10	1000	1000	10	300	750	2500
Bulgaria	30	500	1600	16	350	800	3000
Cyprus	20-40	-	1000-1750	16-25	300-400	750-1200	2500-4000
Denmark	0.8	100	1000	0.8	30	120	4000
Estonia	15	1200	800	16	400	900	2900
France (4)	10	1000	1000	10	200	800	3000
Germany (1)	10	900	800	8	200	900	2500
Greece	20-40	500	1000-1750	16-25	300-400	750-1200	2500-4000
Hungary	10	1000/1(3)	1000	10	200	750	2500
Ireland	20		1000	16	300	750	2500
Italy	20		1000	10	300	750	2500
Lithuania	-	-	-	-	-	-	-
Luxembourg	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000
Portugal	20	1000	1000	16	300	750	2500
Spain	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000

In practice however, information on the quality of sludge seems to indicate that the quality of sludge may be better that the national limits given in Table 11. The information presented in Table 12 is based on country averages, thus although the quality of the sludge seems to be better than those given under the proposed new limits, it can not be stated that all sludge arisings within these are compliant with the new limits. Indeed the first consultation revealed that the content can vary significantly, so these figures need to be read with caution. (In addition, the data do not cover all Member States).

Table 12: Quality of sewage sludge (on dry solids) recycled to agriculture (2006) (Eurostat, 2007) against new Option 2 limits

Parameter	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
New limits Option 2	**10**	**1000**	**1000**	**10**	**300**	**750**	**2500**
BE –Flanders	1	20	72	0.2	11	93	337
BE-Walloon	1.5	54	167	1	25	79	688
Bulgaria	1.6	20	136	1.2	13	55	465
Germany	1	37	300	0.4	25	37	713
Spain	2.1	72	252	0.8	30	68	744
Finland	0.6	18	244	0.4	30	8.9	332

Parameter	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
New limits Option 2	**10**	**1000**	**1000**	**10**	**300**	**750**	**2500**
France	1.3	43	272	1.1	21	50	598
Italy	1.3	86	283	1.4	66	101	879
Portugal	<0.4	20	12	<1	15	27	341
Sweden	0.9	26	349	0.6	15	24	481
UK	1.3	61	295	1.2	30	112	574
Cyprus	6.9	37	180	3.1	21	23	1188
Czech Republic	1.5	53	173	1.7	29	40	809
Estonia	2.8	14	127	0.6	19	41	783
Hungary	1.4	57	185	1.7	26	36	824
Lithuania	1.3	34	204	0.5	25	21	534
Latvia	3.6	105	356	4.2	47	114	1232
Portugal	4	127	153	4.6	32	51	996
Slovenia	0.7	37	190	0.8	29	29	410
Slovakia	2.5	73	221	2.7	26	57	1235

The CBA conducted in 2002 highlighted that the percentage of sludge failing to comply with the new limits on heavy metals could be 12% of the total sludge being produced, in the short term, without pollution prevention[9]. Based on more recent data from our consultation on sludge quality, however, we believe that this may be an overestimate, especially for the EU-15. The amount of sludge assumed to be failing to meet the new heavy metal limits is given in Table 13. These percentages are used in the impact assessment to estimate the costs of Option 2.

Table 13: % recycled sludge failing new limits on heavy metals under Option 2

Austria Belgium • Brussels region (b) • Flemish region • Walloon region	Denmark Finland Netherlands Sweden	0%
France Germany Ireland	Italy Portugal	5%
Greece Luxembourg	Spain United Kingdom	10%
Bulgaria Cyprus Czech republic Estonia Hungary Latvia	Lithuania Malta Poland Romania Slovakia	12%

For the sludge that is failing, there will be two scenarios:

- specific pollution prevention measures are taken to reduce the heavy metals loads in sludge; or

[9] These percentages vary however according to country and range from 0% to 20%.

- alternative disposal options (i.e. to landfill or incineration).

Both of the scenarios will have costs implications for water and sludge management operators. Depending on the specific scenarios, the environmental and social impacts from alternative disposal routes will vary in magnitude. In absence of any information on the different disposal routes, the following estimates have been used to estimate the costs of Option 2, based on information available in the literature and consultation.

Table 14: Impacts from Option 2- disposal options and treatment

Country	% of sludge failing receiving further treatment	% of sludge failing going to incineration with energy recovery	% of sludge failing going to landfill
Austria Belgium Denmark Finland Sweden Germany Slovenia	40%	60%	0
France Ireland Italy Portugal United Kingdom	30%	50%	20%
Greece Luxembourg Spain	10%	50%	40%
Bulgaria Cyprus Czech Republic Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia	10%	20%	70%

Question for the consultation

Q 3 - Do you agree with our estimates of recycled sludge failing the limits on heavy metals and the impacts on disposal and treatment?

The 2002 assessment estimated costs for reduction of PTEs of around €200/tDM. The internal costs (marginal increases against average spreading) will be used in order to calculate the economic costs from the increase in alternative routes of disposal.

3.2.2 Limits on organics

The previous report highlighted that currently some MS have limits on organics although this is not the general norm. Some countries such as UK, USA and Canada have not set any limit on organic contaminants (OCs) in sludge suggesting that research indicates that concentrations present are not hazardous to human health, the environment or soil quality. However, other countries have set limits for some OC groups. For example, Germany has set limits for PCBs and dioxins but not PAHs while France has limits for PAHs and PCBs but not dioxins. Denmark has set limits for a range of OCs including linear alkyl sulphonates, nonylphenol and nonylphenol ethoxylates and the phthalate, di(ethylhexyl)phthalate (DEHP). The following Table shows the different limits based on previous consultation.

Table 15: Existing legislative limits on organics

	Polycyclic aromatic hydrocarbon (PAH) mg/kg DS	**Polychlorinated biphenyls (PCB) mg/kg DS**
Option 2	6	0.8
Austria		
Lower Austria	-	0.2 d)
Upper Austria		0.2 d)
Vorarlberg		0.2 d)
Carinthia	6	1
Denmark (2002)	3b	
France	Fluoranthene: 4 Benzo(b)fluoranthene: 2.5 Benzo(a)pyrene: 1.5	0.8c)
Germany (BMU 2002)		0.2 e)
Germany (BMU 2007) f)	Benzo(a)pyrene: 1	0.1 e)
Sweden	3b)	0.4c)
Hungary	10	1
Czech Republic		0.6
Notes: c)sum of 7 congeners: PCB 28, 52, 101, 118, 138, 153, 180 d)sum of 6 congeners:PCB28,52,101,138,153,180 e)Per congener f)Proposed new limits in Germany (BMU 2007)		

Out of the 40 consultees' responses to the first consultation, eight would like OC limits, or stricter limits than currently in place in some location (with another respondent stating that any recycling is unacceptable), five argued that there is no evidence of sufficient risk to require limits on OCs, and another four would prefer it if limits were based on a common risk assessment and applied generally.

There were no common views amongst those responding in favour of introducing EU limits on OCs in sewage sludges on which substances should be regulated. Under Option 2, we have assumed that limits are set on PCBs and PAHs as follows:

Table 16: Limit values for organics in sludge

PAH	6mg/kg dry matter
PCB	0.8 mg/kgdry matter

Under this option, most MS will be affected, excluding:

- Austria (three of Austria's nine states already have a sufficient limit on PCBs in place and another state [Carinthia] has a limit on PAH and a limit on PCBs that is slightly higher than the proposed 0.8 mg/kg);
- Denmark (currently only has a limit on PAH);
- France;
- Germany;
- Sweden; and
- Czech Republic (will comply with PCB limit but not limit on PAH).

The IA in 2003 estimated that 50% of sludge meeting the new heavy metal limits would fail to meet the new organics limits (although this included more standards than those proposed under this Option). We believe this could indicate an overestimate of the sludge failing on organics only on the basis that quality of sludge has improved since 2002. However, there is limited evidence on this. Although there appear to be a reduction of organic content, there are no detailed data on the amount of OC in sludges at different concentrations.

We believe that 10 to 40% may be a better estimate of the sludge failing the new limits on OCs. A smaller amount will be affected for those countries with some relevant limit in place already. Similarly, the degree of impacts will depend on the response by the stakeholders.

Table 17: % recycled sludge failing the new limits on OCs under Option 2

Czech Republic Denmark	10%
Belgium • Brussels region (b) • Flemish region • Walloon region Finland	20%
Ireland Italy Portugal	30%
Greece Luxembourg Spain United Kingdom	40%
Bulgaria Cyprus Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia Slovenia	12%

The scenarios for the sludge failing the new standards would be, as before, changing the routes of disposal and/or treating the sludge. The 2002 assessment estimated costs for reduction of OCs of around €200/tDM. The same trends as for heavy metals will be applied for considering the impacts on alternative disposal options (Table 14).

Question for the consultation

Q 4 - Do you agree with our estimates of recycled sludge failing the limits on organic contaminants and the impacts on disposal and treatment?

3.2.3 Standards for pathogens

Seventeen respondents to the first consultation specifically mentioned or discussed pathogens in sludge. Most of these either inferred or specifically described the evidence that there have been no adverse health effects on humans, animals or plants whilst using sludge for agriculture treated and recycled in accordance with the Sludge Directive requirements. Five of the respondents specifically described a desire for pathogen controls to be based on different standards for different purposes, and possibly even with requirements adjusted by location as well, whilst three respondents would prefer consistent or harmonised controls.

None of the respondents made any specific recommendations other than by referring to existing quality limits or more stringent recycling controls used in some Member States either as regulatory controls or as codes of practice.

Option 2 will involve introducing standards for pathogens in line with the conventional treatment as given in the Commission Communication in 2003. Conventional treatment means any sludge treatment capable of achieving a reduction in *Escherichia coli* to less than $5x10^5$ colony forming units per gram (wet weight) of treated sludge.

Currently, only a few MS are known to have limits on pathogens, shown in Table 18. The 2002 CBA concluded that pollution prevention for pathogens by reducing at source was not feasible. However, local controls which specify indicator pathogen limits in the sludge have been implemented in several of the EU15 countries, driven by stakeholder demands. Sludge producers have installed new treatment processes that achieve more reliable and greater levels of pathogen destruction during treatment. Countries without equivalent systems to conventional standard however are using anaerobic digestion or aerobic digestion but this may not reliably achieve standard.

Table 18: Standards for maximum concentrations of pathogens in sewage sludge (Sede and Andersen, 2002; Alabaster and LeBlanc, 2008)

	Salmonella	**Other pathogens**
Denmark a)	No occurrence	Faecal streptococci:< 100/g
France a)	8 MPN/10 g DM	Enterovirus: 3 MPCN/10 g of DM Helminths eggs: 3/10 g of DM
Finland (539/2006)	Not detected in 25 g	Escherichia coli <1000 cfu
Italy	1000 MPN/g DM	
Luxembourg	-	Enterobacteria: 100/g no eggs of worm likely to be contagious
Hungary	-	Faecal coli and faecal streptococci decrease below 10% of original number
Poland	Sludge cannot be used in agriculture if it contains salmonella	

No attempt has been made at this time to closely model the forms of sludge treatment used in each country as the combinations of sewage and sludge treatment processes lead to a very wide variety of possible scenarios. Consultation for the interim report revealed that the % of sludge being treated with anaerobic digestion can range from 20% (Norway) to 49% (Belgium). This sludge will have to be treated further in order to meet the new limits on pathogens. The following estimates are used for our calculations.

Table 19: % sludge affected under new treatment

Czech Republic Belgium Italy Portugal Greece Luxembourg Spain United Kingdom Bulgaria Cyprus Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia Slovenia	40%
Denmark Finland Ireland	20%
Austria France Germany Netherlands Sweden	0%

In order to estimate the cost, the assumption is that the failing sludge will be treated with lime. Adding lime would bring such failing treatments to conventional standards. The costs of adding lime to an existing treatment have been estimated at around €22/t Raw DS (operating cost).

Questions for the consultation

Q 5 – What percentage of sludge will be affected by the new limits on pathogens and will receive further treatment? Would this treatment consist of adding lime?

3.2.4 Provision of Information on Nutrients

As for the component providing information on nutrients, this is unlikely to affect MS significantly. This is because there is currently a requirement to measure N&P in accordance with the existing directive although the frequency is relatively low (6 months or when significant changes in quality).

3.2.5 Other changes concerning quality and aimed at prevention

Option 2 will require that sludge shall be stabilised (or pseudo-stabilised) to reduce degradability during field side storage or after landspreading, to reduce methane emissions during storage and after landspreading, and to reduce odours. There are a number of means of demonstrating stability from which the most appropriate measurement may be agreed; for example, achieving 38% volatile solids reduction, or demonstrating that the specific oxygen uptake rate of the sludge is less than 1.5mgO_2/hour/g total solids. The conditions required to achieve these targets would be part of a Hazard Analysis and Critical Control Point (HACCP) system with monitoring and measurement as appropriate. There is no accurate information on the costs of HACCP however.

Questions for the consultation

Q 6 – Do you have and can you provide costs data on HACCP? Please provide estimates of the number of staff or time required per installation if feasible.

3.2.6 Change in limits on heavy metals based on soil conditions

Option 2 will involve changes to Annex IA, with more stringent limits of heavy metals in soil as proposed below.

Table 20: Proposed limit values of heavy metals in soil

PTE	86/278/EEC (6<pH<7)	5≤pH<6	6<pH<7	pH≥7
Cd	1-3	0.5	1	1.5
Cr	-	50	75	100
Cu	50-140	30	50	100
Hg	1-1.5	0.1	0.5	1
Ni	30-75	30	50	70
Pb	50-300	70	70	100
Zn	150-300	100	150	200

Table 21 sets out the maximum permissible concentrations in soil across different MS. Grey highlight denotes that the national limit is higher than proposed under Option 2. When there is no distinction based on pH, the highest bound has been applied.

Table 21: Maximum permissible concentrations of potentially toxic elements in sludge-treated soils (mg kg^{-1} dry soil) in EC Member States, (SEDE and Andersen, 2002)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Option 2 5£pH<6	**0.5**	**50**	**30**	**0.1**	**30**	**70**	**100**
Option 2 6<pH<7	**1**	**75**	**50**	**0.5**	**50**	**70**	**150**
Option2 pH³7	**1.5**	**100**	**100**	**1**	**70**	**100**	**200**
Austria							
Lower Austria	1.5/1h)	100	60	1	50	100	200
Upper Austria	1	100	100	1	60	100	300/150(9)
Burgenland	2	100	100	1.5	60	100	300
Vorarlberg	2	100	100	1	60	100	300
Steiermark	2	100	100	1	60	100	300
Carinthia	0.5	50	40	0.2	30	50	100

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Option 2 5£pH<6	**0.5**	**50**	**30**	**0.1**	**30**	**70**	**100**
Option 2 6<pH<7	**1**	**75**	**50**	**0.5**	**50**	**70**	**150**
Option2 pH³7	**1.5**	**100**	**100**	**1**	**70**	**100**	**200**
if 5<pH<5.5							
if 5.5<pH<6.5	1	75	50	0.5	50	70	150
if pH>6.5	1.5	100	100	1	70	100	200
Belgium-Brussels	2		50	1	30	50	150
Belgium, Flanders	0.9	46	49	1.3	18	56	170
Belgium, Wallonia	2	100	50	1	50	100	200
Bulgaria							
pH=6-7.4	2	200	100	1	60	80	250
pH>7.4	3	200	140	1	75	100	300
Cyprus	1-3		50-140	1-1.5	30-75	50-300	150-300
Denmark	0.5	30	40	0.5	15	40	100
Finland	0.5	200	100	0.2	60	60	150
France	2	150	100	1	50	100	300
Germany (6)	1.5	100	60	1	50	100	200
Germany (7)							
Clay	1.5	100	60	1	70	100	200
Loam/silt	1	60	40	0.5	50	70	150
Sand	0.4	30	20	0.1	15	40	60
Greece	3	-	140	1.5	75	300	300
Ireland	1	-	50	1	30	50	150
Italy	1.5	-	100	1	75	100	300
Luxembourg	1-3	100-200	50-140	1-1.5	30-75	50-300	150-300
Estonia (10)	3	100	50	1.5	50	100	300
Hungary	1	75/1 (8)	75	0.5	40	100	200
Latvia	0.5-0.9	40-90	15-70	0.1-0.5	15-70	20-40	50-100
Lithuania	1.5	80	80	1	60	80	260
Malta							
pH 5<6	0.5	30	20	0.1	15	70	60
pH 6-7	1	60	50	0.5	50	70	150
pH >7	1.5	100	100	1	70	100	200
Netherland	0.8	10	36	0.3	30	35	140
Portugal							
Soil ph<5.5	1	50	50	1	30	50	150
5.5<soil<7	3	200	100	1.5	75	300	300
Soil ph>7	4	300	200	2	110	450	450
Poland							
Light soil	1	50	25	0.8	20	40	80
Medium soil	2	75	50	1.2	35	60	120
Heavy soil	3	100	75	1.5	50	80	180
Romania	3	100	100	1	50	50	300
Slovakia	1	60	50	0.5	50	70	150
Slovenia	1	100	60	0.8	50	85	200
Spain							
Soil ph<7	1	100	50	1	30	50	150
Soil ph>7	3	150	210	1.5	112	300	450
Sweden	0.4	60	40	0.3	30	40	100
UK(1)	3	400 (5)	135	1	75	300 (3)	20

Notes:

(1) For soil of pH ≥5.0, except Cu and Ni are for pH range 6.0 – 7.0; above pH 7.0 Zn = 300 mg kg-1 ds (DoE, 1996);
(2) Approximate values calculated from the cumulative pollutant loading rates from Final Part 503 Rule (US, EPA 1993);
(3) Reduction to 200 mg kg-1 proposed as a precautionary measure;
(4) EC (1990) – proposed but not adopted;
(5) Provisional value (DoE, 1989).
(6) Regulatory limits as presented in the German 1992 Sewage Sludge Ordinance (BMU, 2002)
(7) Proposed new German limits (BMU, 2007)
(8) Chromium VI
(9) For ph<6
(10) In soils where 5<ph<6 it is permitted to use lime-sterilised sludge

Source: Andersen and Sede (2002a): Disposal and Recycling Routes for Sewage Sludge Regulatory sub-component report – Part 1, 29 January 2002 as reproduced in DSR1 p.19

Note: Unless specified otherwise, we assume that limits listed in Andersen & Sede (2002) refer to ph between 6 and 7. Where Member State legislation includes ranges, the higher limit is taken as indicative of compliance with proposed Option 2

The above table depicts a number of MS with less stringent limits. However, this may not relate to the actual concentrations in soil. There is limited information on the percent of soil at different concentrations of pH. The previous IA estimated that the percent of soil failing the new standards would range from 10% to 100% in some MS (the latter is relevant to the UK). However, the 100% figure is based on compounding data on the proportion of land failing to comply with limits on individual heavy metals and as such represents a worst-case scenario and we believe that it may be an overestimate. Indeed WRc estimated that 40% of the total agricultural land in the UK will not be available for sludge recycling should these limits be implemented[10]. Thus, this component is expected to have impacts on the land available for spreading. The following Table presents our estimates on the % of land failing for estimating the costs in terms of fertiliser replacement.

Table 22: % of failing land considered under Option 2

Malta The Netherlands Sweden	Slovakia Denmark	0%
Austria Ireland Germany	Finland Spain	10%
Czech Republic Belgium Italy Portugal Greece Luxembourg United Kingdom Bulgaria	Cyprus Estonia Hungary Latvia Lithuania Poland Romania Italy France	30%

We believe production will be maintained through the application of fertiliser replacing sludge on land that fails the new standards. Fertiliser prices for nitrogen (N), phosphate (P) and potash (K) are reported to be €400/tonne, €754/tonne and €633/tonne respectively. The application rate is set by the crop demand for

[10] based on the following concentrations in soil:Cd – 0.6, Cr – 84, Cu – 26, Hg – 0.1, Ni – 34, Pb – 29, Zn – 60

NPK. There is a max for N of 250kg N/ha max, but this is generally P rich in sludge. The equivalent annual rate of N for a fertiliser would be about 70kg N (as sludge is long release N). Sludge N is say 40kg/tDM, (which is 50% available in year 1).

It is very difficult to anticipate the costs of fertiliser replacement and there is not enough information about the percentage of sludge by type applied to the different types of crops. Because of this, the savings given in Annex 2 Fertiliser replacement costs and changes in crop yield have been used (taking €65/tDM as that seems the most common value)**.** This assumes that production will be maintained through the application of fertiliser and that agricultural output will not be affected.

Questions for the consultation

Q 7 – What do you expect the % of total agricultural land to be failing to comply on the new limits of heavy metals in soil? Would production be maintained through the application of fertiliser?

3.2.7 Setting conditions on application

Article 7 of the Directive 86/278/EEC sets restrictions on the spreading of sludge on grassland and forage crops, and on land on which vegetables and fruits are grown. For grassland and forage crops, it requires a minimum period of 3 weeks between sludge application and grazing or harvest. For fruit and vegetable crops in direct contact with soil and normally eaten raw, a period of 10 months is required.

These dispositions have been transposed by Member States with some variations. Ireland, Portugal and the United Kingdom have transposed the exact requirements of the directive. Other countries have introduced longer delays before spreading (Austria, Belgium, Estonia, Italy, and Luxembourg). Some countries have introduced additional restrictions for specific crops such as a ban for grassland in Austria, Latvia, Poland and Sweden, or on agricultural practices, such as direct ploughing (e.g. in Finland) or the use of pasteurised / enhanced treated / hygienised sludge (e.g. in France, where delay before spreading is greater when not using pasteurised / hygienised sludge).

Most countries have also introduced additional requirements for landspreading such as restricting the use of sludge in agriculture near surface water, in forests, on frozen or snow-covered ground, and on sloping land in order to reduce the impact of erosion and run-off. Requirements may also be added in order to protect groundwater. Additional recommendations have also been introduced in codes of practice or voluntary agreements (i.e. the UK Safe Sludge Matrix).

Although there appears to have been no evidence of risks due to landspreading when carried out according to the existing rules, Option 2 will entail moderate changes to Article 7 as highlighted above and repeated here for the sake of analysis:

- Setting periods for harvesting for grassland and/or forage crops;
- Make compulsory 10 month period for fruit and vegetable crops;
- Ban the application of untreated sludge - changes to Article 6 which currently allows MS to authorise under certain conditions the use of untreated sludge if injected or worked into the soil. Outright ban on the use of untreated sludge injected or worked into the soil – changes to Article 6; and
- Liquid sludge may only be used if injected or immediately worked into soil.

The main costs implications are expected to arise from the ban on untreated sludge on those MS currently using it untreated, and the requirement that liquid sludge may only be injected or immediately worked into the soil. The other conditions are not expected to impact significantly. Untreated sludge is not currently widely

applied. Liquid sludges (less than 10% DM) are more widely used, but other EU regulations to limit nutrient enrichment of waters are expected to encourage timely mixing of sludge and soil to avoid surface run-off. **These impacts have not been quantified in this report because of lack of data so your feedback on this question is valuable.**

Questions for the consultation

Q 8 – What % of total agricultural land do you expect will be affected by the ban on injecting untreated sludge and/or liquid sludge into the soil? Will there be costs arising from these new conditions?

3.2.8 Changes to sampling and monitoring requirements

Option 2 will involve changes to sampling and monitoring requirements in line with Annex VI of CEC (2003) and concerning the frequency of sampling and monitoring with at least the frequency shown in the following table:

Table 23: Proposed analysis

Quantity of sludge produced per year and per plant (tonnes of dry matter)	**Minimum number of analyses per year**				
	Agronomic parameters	Heavy metals	Organic compounds (except dioxins)	Dioxins	Micro-organisms
< 50	1	1	-	-	1
50 – 250	2	2	-	-	2
250 – 1 000	4	4	1	-	4
1 000 – 2 500	4	4	2	1	4
2 500 – 5 000	8	8	4	1	8
> 5 000	12	12	6	2	12
The frequency of analysis of any of the parameters (heavy metals, organic compounds, micro-organisms) may be reduced if it has been shown that in a two-year period each measured value of the parameter is consistently below 75% of the limit. The analysis of organic compounds may be omitted if it has been shown that in a two-year period each measured value of the parameter is consistently below 25% of the limit. The frequency of analysis of any of the agronomic parameters may be reduced if in a two-year period it has been shown that each measured value of the parameter deviates by less than 20% from the average. There are some allowances for the number of samples that can fail within certain deviation, a maximum of 2 for any substance and limit, within a maximum of 20% deviation.					

In addition, it has been proposed that CEN TC 308 procedures are introduced. TC 308 concerns the standardization of the methods for characterising and classifying sludges and products from storm water handling, night soil, urban wastewater collection systems, wastewater treatment plants for urban and similar industrial waters (as defined in EC directive 91/271/EEC1), water supply treatment plants, but excluding hazardous sludges from industry. The sampling methods included are the physical, chemical and microbiological analyses required for characterising these sludges with a view to facilitating decisions on the choice of the treatment procedures and of the utilization and disposal. Included is the drafting of good practice documents in the production, utilization and disposal of sludges. The Scope of the TC considers all sludges that may have similar environmental and/or health impacts. Quality assurance system costs were

estimated by Andersen and Sede (2002) at €15/tDM (updated to €18/tDM in 2009 values). Quality assurance systems will have to be applied to all sludge recycled; so costs are likely to be significant.

Questions for the consultation

Q 9 – What are the costs implications of these new monitoring requirements? Please explain (e.g. number of additional FTE, administrative costs, etc.)

3.3 Impacts from Option 2

Overall, when the national limits are less stringent than the new limits the percentile sludge quality distribution will help to assess the quantity of sludge failing to meet the requirement. We have limited information on the percentile sludge distribution in different MS however. Information is available on the average sludge content. Thus we have produced informed guesses on the amount of sludge affected. The following Table present a summary of the impacts deemed more important, as well as the approach. More explanations are given in the relevant sections, including when impacts are not considered significant and any justifications.

Table 24: Option 2 – overview of impacts considered and approach

Economic impacts	Stakeholder	Description	Quantified?
Costs of alternative disposal	Water and sludge management operators	As sludge recycled is likely to be affected, there will be internal costs from its disposal	Yes
Obligation of treatment	Water and sludge management operators	Sludge will have to be treated in order to be applied to agriculture	Yes
Pollution prevention costs	Water and sludge management operators	As above, but pollution prevention costs in this IA relate to reduction in loads of contaminant in sewers	Partly
Policy implementation and control	Regulators	There will be costs from changing legislation and consultation (not monetised) and monitoring (included under pollution prevention)	Partly
Benefits if meeting related legislation requirements (e.g. WFD)	Regulators	More stringent standards likely to influence positively meeting the objectives of other legislation	No
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Farmers	As quantities of sludge recycled will be reduced, they will have to be replaced by fertiliser	Yes
Loss of agricultural output/crops	Farmers	There could be impacts on crops in the short term and depending on availability of fertiliser as a replacement. Assumes production will be kept so impact negligible	No
Environmental impacts			
Environmental benefits from reduced application	General public	Impacts on biodiversity, ecosystems, quality of water and groundwater from reduced risk and application. But owing to national practices and standards, benefits uncertain.	No

Benefits/costs from alternative routes of disposal including climate change	General public	Impacts from increase in use of landfill and incineration for failing sludge. Values include externalities from emissions (including energy recovery): air pollution as well as climate change impacts In the next stage of the impact assessment, further work could quantify certain impacts in greater detail (e.g. emissions of CO_2)	Partly
Social Impacts			
Human health benefits from reduced application	General public	Owing to national practices and standards, benefits uncertain.	No
Human health from alternative routes of disposal	General public	Values include human health externalities from emissions (including energy recovery)	Yes

Concerning PTE, most of the MS average sludge quality is above the standards proposed for Option 2. Thus the impacts of the amount of sludge being produced or recycled are not expected to be significant from the modification of limits on heavy metals alone. The 2002 report estimated that the percentages of sludge affected by the new limits would range from 0% to 20% of total sludge production, under the no pollution prevention policy scenario. This may be an overestimate owing to improvements since 2002. There will be more costs implications from the limits of heavy metals in soils. The impacts are described in more detail below.

3.3.1 Economic Impacts

The main costs from this Option relate to:

- Costs of pollution prevention measures to reduce heavy metals and organic compounds loads in sludge in order to meet the standards. The 2002 assessment estimated the same costs for both of around €200/tDM (updated to €240/tDM in 2009 values) with costs of €74 to €134/tDM for pathogen treatment and €12/tDM for local authority costs;
- Costs related to the alternative routes of disposal for the sludge failing (landfill or incineration) and not subject to pollution reduction control;
- Reduced application of sludge to land and fertiliser replacement costs for the land affected by limits in soil; and
- Costs associated with quality assurance.

There will also be costs to regulatory authorities concerning changes to legislation and monitoring and costs of sampling to sludge producers/regulatory authorities (guidance costs indicate that PAH and PCB analysis each have costs in the region of €90, or €180 per sample). These have not been valued above.

The following Table shows estimates of these costs based on the assumptions presented throughout this section.

Table 25: Economic Impacts from Option 2 incurred between 2010 - 2020 (PV costs)

Country	Costs due to further treatment (low)	Costs due to further treatment (high)	Costs because of increased landfill	Costs because of increased incineration (low)	Costs because of increased incineration (high)	Quality assurance related costs	Fertiliser replacement costs
Austria	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Belgium	€ 3,700,000	€ 4,700,000	€ 0	€ 4,200,000	€ 6,300,000	€ 1,100,000	€ 140,000
Denmark	€ 11,000,000	€ 15,000,000	€ 0	€ 13,000,000	€ 20,000,000	€ 3,300,000	€ 3,200,000
Finland	€ 1,000,000	€ 1,200,000	€ 0	€ 730,000	€ 1,100,000	€ 190,000	€ 9,100
France	€ 32,000,000	€ 32,000,000	€ 10,000,000	€ 33,000,000	€ 49,000,000	€ 10,000,000	€ 13,000,000
Germany	€ 25,000,000	€ 25,000,000	€ 0	€ 24,000,000	€ 35,000,000	€ 5,900,000	€ 2,800,000
Greece	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Ireland	€ 22,000,000	€ 24,000,000	€ 5,300,000	€ 17,000,000	€ 25,000,000	€ 5,100,000	€ 6,100,000
Italy	€ 80,000,000	€ 97,000,000	€ 22,000,000	€ 71,000,000	€ 110,000,000	€ 21,000,000	€ 7,400,000
Luxembourg	€ 840,000	€ 970,000	€ 1,100,000	€ 1,700,000	€ 2,500,000	€ 510,000	€ 540,000
Netherlands	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Portugal	€ 58,000,000	€ 69,000,000	€ 16,000,000	€ 51,000,000	€ 76,000,000	€ 15,000,000	€ 14,000,000
Spain	€ 110,000,000	€ 120,000,000	€ 140,000,000	€ 220,000,000	€ 330,000,000	€ 66,000,000	€ 110,000,000
Sweden	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
United Kingdom	€ 430,000,000	€ 500,000,000	€ 92,000,000	€ 290,000,000	€ 440,000,000	€ 89,000,000	€ 120,000,000
EU15	€ 770,000,000	€ 890,000,000	€ 290,000,000	€ 730,000,000	€ 1,100,000,000	€ 220,000,000	€ 270,000,000
Bulgaria	€ 3,000,000	€ 3,700,000	€ 11,000,000	€ 4,000,000	€ 6,100,000	€ 3,300,000	€ 3,000,000
Cyprus	€ 420,000	€ 530,000	€ 1,600,000	€ 570,000	€ 860,000	€ 450,000	€ 440,000
Czech Republic	€ 4,900,000	€ 6,300,000	€ 20,000,000	€ 7,100,000	€ 11,000,000	€ 5,400,000	€ 3,400,000
Estonia	€ 880,000	€ 1,100,000	€ 3,300,000	€ 1,200,000	€ 1,800,000	€ 910,000	€ 770,000
Hungary	€ 3,700,000	€ 4,600,000	€ 14,000,000	€ 5,000,000	€ 7,500,000	€ 3,900,000	€ 2,400,000
Latvia	€ 1,000,000	€ 1,300,000	€ 3,900,000	€ 1,400,000	€ 2,100,000	€ 1,100,000	€ 970,000
Lithuania	€ 2,000,000	€ 2,500,000	€ 7,400,000	€ 2,700,000	€ 4,000,000	€ 2,000,000	€ 1,600,000
Malta	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Poland	€ 9,300,000	€ 12,000,000	€ 35,000,000	€ 13,000,000	€ 19,000,000	€ 9,900,000	€ 4,000,000
Romania	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Slovakia	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Slovenia	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
EU12	**€ 25,000,000**	**€ 32,000,000**	**€ 96,000,000**	**€ 35,000,000**	**€ 52,000,000**	**€ 27,000,000**	**€ 17,000,000**
EU27	**€ 800,000,000**	**€ 930,000,000**	**€ 380,000,000**	**€ 760,000,000**	**€ 1,100,000,000**	**€ 250,000,000**	**€ 280,000,000**

The main sources of uncertainty concern the following:

- Using generic data for each country on % of sludge that may fail (Table 13: % recycled sludge failing new limits on heavy metals under Option 2; Table 17: % recycled sludge failing the new limits on OCs under Option 2; Table 22: % of failing land considered under Option 2);

- Using assumptions on costs of further treatment based on % of adjusted costs to reflect that not all sludges will need to be treated for heavy metals, OCs, and pathogens; and

- Using costs that are not specific to individual countries or approaches commonly used in each country to deal with sludge (other than simple assumptions on percent failures in each country; Table 14: Impacts from Option 2- disposal options and treatment).

Your feedback will help us refine these assumptions, reducing uncertainty.

3.3.2 Environmental Impacts

The EFAR report (2007) concluded that global risk based on the results of the quantitative risk assessment was acceptable under the following:

- limits proposed under Annex III of the CEC (2003) communication;
- Bis(2-ethylhexyl) phthalate (DEHP) limit of 100mg/kg DM; and
- Lower limit for lead of 500mg/kg DM (as opposed to 750 mg/kg).

This would suggest that when the limits are not set at this level, there could be limited benefits in terms of reduced health risk. When national limits are more stringent and/or the quality of the sludge complies with such limits, the benefits in terms of health risk are expected to be negligible. The current limits on DEHP seem highly variable and appear to be unlinked to other substances. A European range is of 0.095 to 47mg/kg DS, median 7.2. Other limits include:

- UK: 0.3 to 1020 mg/kg with median of 110 mg/kg;
- Norway: 17 to 178 mg/kg with median of 53 mg/kg; and
- N Rhine: 0.93 to 110 mg/kg with median of 22 mg/kg and 90%ile of 57 mg/kg.

Thus, there may be benefits from reducing DEHP however, this OC is not addressed under Option 2. Thus, the environmental impacts from reduced risk in application are limited against the baseline.

The main environmental costs from this Option relate to the environmental impacts from the alternative routes of disposal. Assuming the above percentages of sludge going to the different routes, the impacts have been valued and are given in the following Table. Note that these include the human health costs from increases in quantities going to other disposal options.

The main sources of uncertainty with regard to the values below are as follows:

- Actual usage/type of landspreading not known, which may over or under-estimate additional externalities from moving to landfill or incineration;
- Distances that sludge would be transported under baseline option and Option 2 not known, suggesting these estimates are indicative of the potential costs;
- Some environmental costs are not included (as listed above); and
- Some human health impacts may be captured within the costs.

Table 26: Environmental and Human Health Impacts from Option 2 incurred between 2010 - 2020 (PV costs)

Country	Environmental costs (to landfill)	Environmental costs (to incineration)
Austria	€ 0	€ 0
Belgium	€ 0	€ 1,200,000
Denmark	€ 0	€ 3,700,000
Finland	€ 0	€ 210,000
France	€ 630,000	€ 9,400,000
Germany	€ 0	€ 6,700,000
Greece	€ 0	€ 0
Ireland	€ 320,000	€ 4,800,000
Italy	€ 1,400,000	€ 20,000,000
Luxembourg	€ 65,000	€ 480,000
Netherlands	€ 0	€ 0
Portugal	€ 970,000	€ 15,000,000
Spain	€ 8,400,000	€ 63,000,000
Sweden	€ 0	€ 0
United Kingdom	€ 5,600,000	€ 84,000,000
EU15	€ 17,000,000	€ 210,000,000
Bulgaria	€ 680,000	€ 1,200,000
Cyprus	€ 96,000	€ 160,000
Czech Republic	€ 1,200,000	€ 2,000,000
Estonia	€ 200,000	€ 340,000
Hungary	€ 840,000	€ 1,400,000
Latvia	€ 240,000	€ 400,000
Lithuania	€ 450,000	€ 770,000
Malta	€ 0	€ 0
Poland	€ 2,100,000	€ 3,600,000
Romania	€ 0	€ 0
Slovakia	€ 0	€ 0
Slovenia	€ 0	€ 0
EU12	€ 5,800,000	€ 9,900,000
EU27	€ 23,000,000	€ 220,000,000

Your feedback will help us refine these assumptions, reducing uncertainty.

3.3.3 Social Impacts

The human health impacts from the alternative disposal options are included in the above estimates. Thus, they are only related to the externalities from alternative routes of disposal and not changes in risk from reduced/increased recycling.

Under this Option however, there are a number of assumptions that will increase the uncertainty of estimates. These include:

- Actual usage/type of landspreading not known which may over or under-estimate additional externalities from moving to landfill or incineration;
- Distances that sludge would be transported under baseline option and Option 2 not known, suggesting these estimates are indicative of the potential costs; and
- There will not be impacts on agricultural production as recycled sludge which will not meet the standards will be replaced by fertiliser, hence the impacts on employment will be limited.

Your feedback will help us refine these assumptions, reducing uncertainty.

3.4 Summary of Costs and Benefits and Distributional Impacts from Option 2

Impacts on MS from Option 2 are likely from inclusion of limits on organics, PCBs and PAHs and pathogens. The following Table presents the summary of economic, environmental and social costs for Option 2. According to the 2002 report, the total cost from Option 2 will be of around €0.8bn per year, including the following costs categories:

- Pollution prevention costs;
- Switching from land spreading to incineration (investment and operational costs, fertiliser replacement costs and external costs to citizens);
- Quality assurance systems; and
- Obligation of treatment.

We believe this may be an over estimate of the total costs owing to improvement in practices since 2002. Our estimates suggest annual costs of around €320 million to €380 million per year.

The Table also sets out the percentages of costs falling on the different MS according to their contribution to the total costs. As it can be seen, UK, Spain, France and Germany are the MS sporting the greatest costs. Of the new MS, Poland and the Czech Republic are bearing the greatest costs but the newer MS will only support 6% of the total costs. The costs however do not include all cost types. There will be costs however to the regulatory authorities from changes to the legislation – those regulatory authorities in the MS highlighted in grey colour in **Table 11**. Such costs will include:

i. costs of consultation; and
ii. administrative costs from changes to the national legislation.

Table 27: Impacts from Option 2 incurred between 2010 - 2020 (PV costs)

Country	TOTAL/LOW ESTIMATE	TOTAL/HIGH ESTIMATE	% of EU-15 or EU-12	% of EU-27
Austria	€ 0	€ 0	0%	0%
Belgium	€ 10,000,000	€ 13,000,000	0%	0%
Denmark	€ 35,000,000	€ 44,000,000	1%	1%
Finland	€ 2,200,000	€ 2,700,000	0%	0%
France	€ 110,000,000	€ 130,000,000	4%	4%
Germany	€ 64,000,000	€ 76,000,000	3%	2%
Greece	€ 0	€ 0	0%	0%
Ireland	€ 60,000,000	€ 71,000,000	2%	2%
Italy	€ 220,000,000	€ 280,000,000	9%	9%
Luxembourg	€ 5,200,000	€ 6,200,000	0%	0%
Netherlands	€ 0	€ 0	0%	0%
Portugal	€ 170,000,000	€ 210,000,000	7%	6%
Spain	€ 710,000,000	€ 830,000,000	28%	26%
Sweden	€ 0	€ 0	0%	0%
United Kingdom	€ 1,100,000,000	€ 1,300,000,000	44%	41%
EU15	€ 2,500,000,000	€ 3,000,000,000	100%	93%
Bulgaria	€ 26,000,000	€ 29,000,000	12%	1%
Cyprus	€ 3,700,000	€ 4,100,000	2%	0%
Czech Republic	€ 44,000,000	€ 49,000,000	20%	2%
Estonia	€ 7,600,000	€ 8,400,000	4%	0%
Hungary	€ 31,000,000	€ 35,000,000	14%	1%
Latvia	€ 9,000,000	€ 10,000,000	4%	0%
Lithuania	€ 17,000,000	€ 19,000,000	8%	1%
Malta	€ 0	€ 0	0%	0%
Poland	€ 77,000,000	€ 86,000,000	36%	3%
Romania	€ 0	€ 0	0%	0%
Slovakia	€ 0	€ 0	0%	0%
Slovenia	€ 0	€ 0	0%	0%
EU12	€ 220,000,000	€ 240,000,000	100%	7%
EU27	**€ 2,700,000,000**	**€ 3,200,000,000**		100%

These costs are unlikely to be significant however. Thus, the main stakeholders affected by Option 2 are:

- sludge producers: operators of sewage treatment works would have to upgrade and replace current treatment plant equipment in order to meet the new standards of treatment set out in the regulations and dispose of the sludge that will not be recycled; and

- farmers: who are the sludge users, would have to comply with revised restrictions. Farmers would face costs for replacement inorganic fertilisers (or treated sludge) but there may be costs in terms of losses from agricultural production from prohibition of injecting sludge untreated or worked into the soil. The cost of replacing fertiliser will not exceed 10% of the total costs calculated (except in the case of Spain which will be 11%). Such costs however will represent a benefit to the fertiliser manufacturers.

The 2002 report also estimated €10/tDM for costs of pollution prevention supported by local authorities. These costs have been included within the further treatment costs but they represent less than 10% of the total treatment costs.

Environmental and social costs will accrue from increased incineration and landfill, as these will be the alternative routes for disposal to untreated sludge. These will accrue to all stakeholders. Environmental and social costs are estimated at 8-9% of the total impacts valued. As for the benefits from reduced recycling these are highly uncertain.

There may be some benefits in terms of amenity and public perception. These are highly uncertain however and have not been valued. One other benefit from this Option is that it will help meeting some other legislation objectives, such as WFD objectives.

Questions for the consultation

Q 10 – Do you agree with our assessment? If not, please expand. **Feel free to add comments on the benefits and costs from Option 2 as well as any data that could influence the assessment.**

4 Option 3: Changes to limits (Significant change)

4.1 Overview

Table **3** showed the different components for Option 3. Option 3 will set more stringent standards than Option 2. The Option will consist of the following:

- Changes to the limits on heavy metals concerning the quality of the sludge (as given in the CEC (2003)) and in soil;
- Setting limits for all organic contaminants for sludge quality;
- Introduce standards for treatment compatible with CEC (2003) advanced treatment;
- Provision of information on nutrients;
- Ban of application of sludge for fruit, vegetable crops and grassland; and
- Changes to sampling and monitoring requirements.

The main issues with this Option are similar to those for Option 2, i.e. setting limitations on sludge use from higher standards in areas where there is no added value in terms of human health and the environment. However, as the limits are more stringent the main risks relate to those environmental and human health risks stemming from the environmental impacts of alternative disposal options to the sludge that will not be suitable for use (landfilling and incineration routes). Other issues relate to the ability to replace all sludge with fertiliser, although this is not expected to be significant.

Questions for the consultation

Q 11 – Would your MS be affected by any of the above components? If yes, you can move to the sections below that are relevant. If you believe that Option 3 will not impact you in any way, please state it here and move to Option 4 and/or any of the remaining options**.**

*You can also check the summary of our assessment on Option 3 which can be found at the end of this Chapter (*Section 4.4: Summary of Costs and Benefits and Distributional Impacts from Option 3*)*

4.2 Assessment of Option by component

4.2.1 Changing limits for heavy metal content in sludge

The limits proposed under Option 3 are given in the following Table.

Table 28: Proposed limit values on the content of heavy metals in sewage sludge – Option 3

PTE	mg/kg
Cd	5
Cr	150
Cu	400
Hg	5
Ni	50
Pb	250
Zn	600

Under these new limits more MS national legislation will be affected than under Option 2. Table 29 depicts, in grey colour, the countries that will be affected based on the regulatory limits. All MS, with the

exception of Denmark (which would only have to amend the limit for zinc) would have to amend their legislative limits in respect to all heavy metals. This will have costs implication for the public authorities.

Table 29: Countries potentially affected by Option 3 i. setting limits on Maximum level of heavy metals (mg per kg of dry substance) in sewage sludge used for agricultural purposes - in grey

PTE	Cd	Cr	Cu	Hg	Ni	Pb	Zn
New limits	**5**	**150**	**400**	**5**	**50**	**250**	**600**
Bulgaria	30	500	1600	16	350	800	3000
Cyprus	20-40	-	1000-1750	16-25	300-400	750-1200	2500-4000
Denmark	0.8	100	1000	0.8	30	120	4000
Estonia	15	1200	800	16	400	900	2900
France (4)	10	1000	1000	10	200	800	3000
Germany (1)	10	900	800	8	200	900	2500
Greece	20-40	500	1000-1750	16-25	300-400	750-1200	2500-4000
Hungary	10	1000/1(3)	1000	10	200	750	2500
Ireland	20		1000	16	300	750	2500
Italy	20		1000	10	300	750	2500
Lithuania	-	-	-	-	-	-	-
Luxembourg	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000
Portugal	20	1000	1000	16	300	750	2500
Spain	20-40	1000-1750	1000-1750	16-25	300-400	750-1200	2500-4000

As noted earlier however, the fact that national limits are higher than the proposed standards does not entail that the sewage sludge being produced is of the same quality. Table 30 depicts the MS affected, in grey, against current information on average sludge quality. As noted under Option 2 however, these are national (weighted) averages so they do not show the effect of different distributions. Indeed, we believe that Option 3 limits may rule out 50% of UK medium size works on Cu and Zn. The Andersen & Sede (2002) report estimated that the percentages of sludge affected by the new limits on heavy metals would range from 50% to 80% of total sludge production[11] under the no pollution prevention policy scenario.

Table 30: Quality of sewage sludge (on dry solids) recycled to agriculture (2006) compared with new Option 3 limits

Parameter	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
New limits Option 3	**5**	**150**	**400**	**5**	**50**	**250**	**600**
BE –Flanders	1	20	72	0.2	11	93	337
BE-Walloon	1.5	54	167	1	25	79	688
Bulgaria	1.6	20	136	1.2	13	55	465
Cyprus	6.9	37	180	3.1	21	23	1188

[11] This was estimated for the long term scenario, whose limits are more similar to, but less stringent than, those proposed under this Option.

Parameter	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc
Czech republic	1.5	53	173	1.7	29	40	809
Germany	1	37	300	0.4	25	37	713
Spain	2.1	72	252	0.8	30	68	744
Finland	0.6	18	244	0.4	30	8.9	332
France	1.3	43	272	1.1	21	50	598
Italy	1.3	86	283	1.4	66	101	879
Portugal	<0.4	20	12	<1	15	27	341
Sweden	0.9	26	349	0.6	15	24	481
UK	1.3	61	295	1.2	30	112	574
Estonia	2.8	14	127	0.6	19	41	783
Hungary	1.4	57	185	1.7	26	36	824
Lithuania	1.3	34	204	0.5	25	21	534
Latvia	3.6	105	356	4.2	47	114	1232
Portugal	4	127	153	4.6	32	51	996
Slovenia	0.7	37	190	0.8	29	29	410
Slovakia	2.5	73	221	2.7	26	57	1235

The following Table sets out our assumptions in terms of sludge failing new limits on heavy metals under Option 3.

Table 31: % recycled sludge failing new limits on heavy metals in sludge under Option 3

Austria Belgium • Brussels region (b) • Flemish region • Walloon region Denmark Finland Netherlands Sweden	20%
France Germany Ireland Italy Portugal Greece Luxembourg Spain United Kingdom	50%

Bulgaria Cyprus Czech republic Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia Slovenia	60%

For the sludge failing, there will be two scenarios:

- specific pollution prevention measures are taken to reduce the heavy metals loads in sludge; and
- alternative disposal options.

Both of the scenarios will have costs implications for water and sludge management operators. Depending on the specific scenarios, the environmental and social impacts from alternative disposal routes will vary in magnitude. In absence of any information on the different disposal routes, the following estimates will be used based on information available in the literature and consultation.

Table 32: Impacts from Option 3 – disposal options and treatment

Country	% of sludge failing receiving further treatment	% of sludge failing going to incineration with energy recovery	% of sludge failing going to landfill
Austria Belgium Denmark Finland Netherlands Sweden Germany Slovenia	40%	60%	0
France Ireland Italy Portugal United Kingdom	30%	50%	20%
Greece Luxembourg Spain	10%	50%	40%

Country	% of sludge failing receiving further treatment	% of sludge failing going to incineration with energy recovery	% of sludge failing going to landfill
Bulgaria Cyprus Czech republic Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia	10%	20%	70%

Question for the consultation

Q 12 - Do you agree with our estimates of sludge failing the limits on heavy metals and the likely percentages receiving further treatment or going for incineration/landfill?

4.2.2 Set limits on organics

Under Option 3, new standards will be introduced for all organics. The proposed standards for PCBs and PAHs will be the same as those suggested under Option 2. However, additional limits will be introduced for PCDD/F, LAS and NPE. These are set out in Table 33.

Table 33: New limits on organics proposed under Option 3

	Limit value
PAH[12]	6 mg/kg dry matter
PCB[13]	0.8 mg/kg dry matter
PCDD/F[14]	100 ng ITEQ/kg dry matter
LAS[15]	5 g/kg dry matter
NPE[16]	450 mg/kg dry matter

As as concerning the regulatory limits, this will impact all MS with the exception of Denmark. From surveys carried out in different countries/regions[17] (Norway, North Rhine Westphalia, UK) the range of

12 Sum of the following polycyclic aromatic hydrocarbons: acenapthene, phenanthrene, fluorene, flouranthene, pyrene, benzo(b+j+k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, indeno(1, 2, 3-c, d)pyrene.

13 Sum of the polychlorinated byphenls components number 28, 52, 101, 118, 138, 153, 180.

14 Polychlorinated dibenzodioxins/ dibenzofuranes.

15 Linear alkylbenzene sulphonates.

16 It comprises the substances nonylphenol and nonylphenolethoxylates with 1 or 2 ethoxy groups.

17 Norwegian Scientific Committee for Food Safety (VKM) 2009; Risk assessment of contaminants in sewage sludge applied on Norwegian soils. www.vkm.no.; Ministry of the Environment, Conservation,Agriculture and Consumer Protection of theState of North Rhine-Westfalia (2005) Characterization and assessment of organic pollutants in Sewage Sludge; Smith S & Riddell-Black

concentrations of different contaminants is wide. Individual components are not necessarily linked with others. The median concentrations in these surveys are within the limit values for Option 3 (apart from UK LAS median concentration of 5.5g/kg DM), with values from 10% to 80% of the limit values, but the maximum values are all greater than the limit values shown. Hence it is expected that the new limits will affect a significant percentage of the total sludge recycled. It is not clear if the amount of sludge affected would be as high as the 50% estimated in the Andersen & Sede (2002) report. Estimates of sludge failing to meet these new OC limits are shown in Table 34.

Table 34: % recycled sludge which may fail the new limits on OCs under Option 3

Denmark	0%
Austria	50%
Belgium	
• Brussels region (b)	
• Flemish region	
• Walloon region	
Finland	
France	
Germany	
Greece	
Ireland	
Italy	
Luxembourg	
Netherlands	
Portugal	
Spain	
Sweden	
United Kingdom	
Bulgaria	
Cyprus	
Czech Republic	
Estonia	
Hungary	
Latvia	
Lithuania	
Malta	
Poland	
Romania	
Slovakia	
Slovenia	

It is not clear what conventional treatment methods could be reasonably used to deal with a failed sludge apart from incineration. It might be possible to dilute the sludge by mixing it with another sludge. High temperature treatments may be capable of improving degradation. The same trends as for heavy metals will be applied for considering the impacts on alternative disposal options (Table 32).

Question for the consultation

Q 13 - Do you agree with our estimates of recycled sludge failing the limits on organic contaminants and the impacts on disposal and treatment?

(2007) Sources and Impacts of past Current and Future contamination of soil: Appendix 2. Organic contaminants. Final report to Defra.

4.2.3 Set standards for pathogens

Option 3 will entail advanced treatment as envisaged in the 2003 communication to deal with pathogens. In other words, 'advanced treatment' means any sludge treatment listed in Table 35 or any other process that sanitises sludge and achieves:

- a 99.99% reduction (in the indicator micro-organism mentioned in Annex I) of *Escherichia coli* to less than $1 \cdot 10^3$ colony forming unit per gram (dry weight) of treated sludge;
- no Ascaris ova;
- a sample of 1 gram (dry weight) of the treated sludge does not contain more than $3 \cdot 10^3$ spores of *Clostridium perfringens*;
- and a sample of 50 grams (wet weight) of the treated sludge does not contain *Salmonella spp*; and
- a 99.99% reduction in *Salmonella senftenberg* W775 for sludge spiked with this micro-organism. This is a process validation and not used on a regular basis; it is used to demonstrate a treatment process is capable of removing Salmonella.

Table 35: Advanced treatments (CEC, 2003)

Type of advanced treatment	Description of process
Windrow composting	All material maintains a temperature of at least 55°C for at least four hours between each turning. The heaps shall be turned at least three times and in any case a complete stabilisation of the material shall be reached. The costs of sludge composting in Germany are between 100 and 200 €/Mg of dry matter for windrow composting[18]
In-vessel composting	All material maintains a temperature of at least 55°C for at least four hours and reaches complete stabilisation.
Thermal drying	Temperature of the sludge particles reaches at least 80°C for ten minutes and moisture content reduced to less than 10%.
Thermophilic aerobic or anaerobic stabilisation	Temperature of at least 55°C for a continuous period of at least four hours after the last feed and before the next withdrawal. Plant should be designed to operate at a temperature of at least 55°C with a mean retention period sufficient to stabilise the sludge.
Thermal treatment of liquid sludge	For a minimum of ten minutes at 80°C or 20 minutes at 75°C or 30 minutes at 70°C followed by mesophilic anaerobic digestion at a temperature of 35°C with a mean retention period of 12 days
Conditioning with quicklime (CaO)	Reaching a pH of at least 12.6 or more and maintaining a temperature of at least 55°C for two hours. The sludge and lime shall be thoroughly mixed.

Table 36 shows the percentage of sludge which is expected to require advanced treatment so that it meets the proposed standards for pathogens. These percentages will be used in the cost-benefit analysis unless other estimates are suggested.

[18] Martin Kraner, Gerold Hafner, Ingrid Berkner, Ertugrul Erdin (2008) Compost from sewage sludge – a product with quality assurance system.

Table 36: % sludge affected under new treatment

Austria France Germany Netherlands Sweden	0%
Denmark, Finland Ireland	50%
Czech Republic Belgium Italy Portugal Greece Luxembourg Spain United Kingdom Bulgaria Cyprus Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia Slovenia	70%

There are other changes proposed under Option 3 concerning quality and aimed at prevention. This would include a requirement for Hazard Assessment and Critical Control Points Assessment (HACCP).

Questions for the consultation

Q 14 – What percentage of sludge will be affected by the new limits on pathogens and will receive further treatment? What is the preferred treatment? Please specify the costs of this treatment if possible.

4.2.4 Provision of Information on Nutrients

As for the component providing information on nutrients, this is unlikely to affect MS significantly. As noted under Option 2, there is currently a requirement to measure N&P in accordance with the existing Directive. The frequency of this measurement is however relatively low, being every six months or when there are significant changes in quality.

4.2.5 Other changes concerning quality and aimed at prevention

Option 3 will require Hazard Analysis and Critical Control Point (HACCP). HACCP applies risk management and control procedures to manage and reduce risk.

Over the last few years Water Companies have adopted HACCP procedures for sludge stream management. In the UK the water utilities have agreed to determine and now carry out HACCP procedures

together with the agreement on different agricultural practices dependent upon the extent of treatment (conventional or enhanced)[19]. This is a one-off assessment to be repeated on any significant process change. But the monitoring and measuring that is identified as necessary would be set within the agreed HACCP. There are no accurate information on the costs of HACCP, and these will vary depending on time and resources needed.

Question for the consultation

Q 15 – What are the costs of HACCP? Please provide estimates of the number of staff or time required per installation if feasible.

4.2.6 Change in limits based on soil conditions

Under Option 3, the limit for zinc in soil with be decreased to 20mg/kg DS for all soils with a pH below 7, where as the proposed limits for Cd, Cr, Cu, Hg, NI and Pb are the same as those specified under Option 2. The proposed values are replicated in the following Table.

Table 37: Limits for PTE in soil – Option 3

PTE	5≤pH<6	6<pH<7	pH≥7
Cd	0.5	1	1.5
Cr	50	75	100
Cu	30	50	100
Hg	0.1	0.5	1
Ni	30	50	70
Pb	70	70	100
Zn	20	20	200

Based on current permissible concentrations of PTEs in sludge treated soils, all member states will be affected to some extent by these revised new limits, in particular those relating to Zn. For example, we estimate that 40% of the total agricultural land in the UK will not be available for sludge recycling should these limits be implemented. This component is expected to have significant impacts on the land which is available for sewage spreading. Table 38 presents our estimates of the percentages of land failing.

Table 38: % of failing land (due to heavy metals) considered under Option 3

Denmark	0%
Austria Ireland Germany Finland Spain Malta Netherlands Sweden Slovakia	20%

[19] Water UK (2004). The application of HACCP procedures in the water industry: biosolids treatment and use on agricultural land. See: http://www.water.org.uk/static/files_archive/0WUK_Haccp_guide_FINAL_19_Mar_04.pdf

Czech Republic Belgium Italy Portugal Greece Luxembourg United Kingdom Bulgaria Cyprus Estonia Hungary Latvia Lithuania Poland Romania Italy France	40%

It is very difficult to anticipate the costs of fertiliser replacement and there is not enough information about the percentage of sludge applied to the different types of crops. Because of this, the savings given in Section Fertiliser replacement costs and changes in crop yield have been used (taking €65/tDM as that seems the most common value). This assumes that production will be maintained through the application of fertiliser and that agricultural output will be affected.

Questions for the consultation

Q 16 – What do you expect the % of total agricultural land to be failing to comply on the new limits of heavy metals in soil set by Option 3? Would production be maintained through the application of fertiliser?

4.2.7 Setting conditions on application

Option 3 proposes a ban on application of sludge for fruit and vegetable crops and a ban for grassland. This component will thus have the following costs implications:

- Costs to sludge producers: quantities of sludge currently used on fruit and vegetable will have to be disposed differently, though incineration and/or landfill; and
- Costs to farmers: fertiliser replacement and, potentially, loss of agricultural production.

Some countries already have considerable restrictions relating to the types of land or timing of application of sewage sludge. The implications of banning the use of sludge on fruit and vegetable crops and grassland are therefore expected to vary significantly by country. Currently, we have limited information on the amount of sludge applied on fruit, vegetable crops and grassland. **These impacts have not been quantified in this report because of lack of data and uncertainty so your feedback is needed.**

The benefits will be counted as benefits to the public in terms of public perception and reduced risk, although the latter cannot be quantified.

Questions for the consultation

Q 17 – What % of total agricultural land do you expect will be affected by the ban? What are the costs implications?

4.2.8 Changes to sampling and monitoring requirements

Under Option 3, sampling and monitoring requirements will be as for Option 2 but Option 3 could have more substances to be tested, including organics.

Table 39: Proposed Analyses

Quantity of sludge produced per year and per plant (tonnes of dry matter)	**Minimum number of analyses per year**				
	Agronomic parameters	Heavy metals	Organic compounds (except dioxins)	Dioxins	Micro-organisms
< 50	1	1	-	-	1
50 – 250	2	2	-	-	2
250 – 1 000	4	4	1	-	4
1 000 – 2 500	4	4	2	1	4
2 500 – 5 000	8	8	4	1	8
> 5 000	12	12	6	2	12
Note that the number of analyses per substance is likely to be the same as under Option 2. However, for Option 3, organics such as PAH, PCB, PCDD/F, LAS and NPE will require testing.					

Questions for the consultation

Q 18 – What are the costs implications of these new monitoring requirements? Please explain (e.g. number of additional FTE, administrative costs, etc.)

4.3 Impacts from Option 3

The impacts from Option 3 are expected to be more significant than for Option 2, due to the more stringent limits and the conditions on application. Similarly, benefits are expected to be greater. Thus we have produced informed guesses on the amount of sludge affected.

The following Table present a summary of the impacts deemed more important, as well as the approach. More explanations are given in the relevant sections, including when impacts are not considered significant and reasons.

Table 39: Option 3 –overview of impacts considered and approach

Economic impacts	Stakeholder	Description	Quantified?
Costs of alternative disposal	Water and sludge management operators	As sludge recycled is likely to be affected, there will be internal costs from its disposal	Yes
Obligation of treatment	Water and sludge management operators	Sludge will have to be treated in order to be applied to agriculture	Yes
Pollution prevention costs	Water and sludge management operators	As above, but pollution prevention costs in this IA relate to reduction in loads of contaminant in sewers	Partly
Policy implementation and control	Regulators	There will be costs from changing legislation and consultation (not monetised) and monitoring (included under pollution prevention)	Partly
Benefits if meeting related legislation requirements (i.e. WFD)	Regulators	More stringent standards likely to influence positively meeting the objectives of other legislation	No
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Farmers	As quantities of sludge recycled will be reduced, they will have to be replaced by fertiliser	Yes
Loss of agricultural output/crops	Farmers	Impacts expected from new conditions on application but these have not been valued due to lack of data.	No
Environmental impacts			
Environmental benefits from reduced application	General public	Impacts on biodiversity, ecosystems, quality of water and groundwater from reduced risk and application. But owing to national practices and standards, benefits uncertain.	No
Benefits/costs from alternative routes of disposal including climate change	General public	Impacts from increase in use of landfill and incineration for failing sludge. Values include externalities from emissions (including energy recovery): air pollution as well as climate change impacts In the next stage of the impact assessment, further work could quantify certain impacts in greater detail (e.g. emissions of CO_2)	Partly
Social Impacts			
Human health benefits from reduced application	General public	Owing to national practices and standards, benefits uncertain.	No
Human health from alternative routes of disposal	General public	Values include human health externalities from emissions (including energy recovery)	Yes

4.3.1 Economic Impacts

The main costs from this Option relate to:

- Costs of pollution prevention measures to reduce heavy metals and organic compounds loads in sludge in order to meet the standards. The 2002 assessment estimated the same costs for both of around €200/tDM (updated to €240/tDM in 2009 values) with costs of €74 to €134/tDM for pathogen treatment and €12/tDM for local authority costs;
- Costs related to the alternative routes of disposal for the sludge failing (landfill or incineration) and not subject to pollution reduction control;

- Reduced application of sludge to land and fertiliser replacement costs for the land affected by limits in soil; and
- Costs associated with quality assurance.

There will also be costs to regulatory authorities concerning changes to legislation. These have not been valued above. The following Table show estimates of these costs based on the assumptions presented throughout this section.

Table 40: Economic Impacts from Option 3 incurred between 2010 – 2020 (PV costs)

Country	Costs due to further treatment (low)	Costs due to further treatment (high)	Costs because of increased landfill	Costs because of increased incineration (low)	Costs because of increased incineration (high)	Quality assurance related costs	Fertiliser replacement costs
Austria	€ 0	€ 0	€ 0	€ 19,000,000	€ 29,000,000	€ 4,900,000	€ 1,400,000
Belgium	€ 6,400,000	€ 8,300,000	€ 0	€ 7,300,000	€ 11,000,000	€ 1,900,000	€ 240,000
Denmark	€ 28,000,000	€ 37,000,000	€ 0	€ 33,000,000	€ 49,000,000	€ 8,200,000	€ 7,900,000
Finland	€ 2,500,000	€ 3,000,000	€ 0	€ 1,800,000	€ 2,700,000	€ 460,000	€ 23,000
France	€ 320,000,000	€320,000,000	€100,000,000	€ 330,000,000	€490,000,000	€100,000,000	€130,000,000
Germany	€ 250,000,000	€250,000,000	€ 0	€ 240,000,000	€350,000,000	€ 59,000,000	€ 28,000,000
Greece	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Ireland	€ 37,000,000	€ 41,000,000	€ 8,800,000	€ 28,000,000	€ 42,000,000	€ 8,500,000	€ 10,000,000
Italy	€ 140,000,000	€ 170,000,000	€ 39,000,000	€ 120,000,000	€190,000,000	€ 38,000,000	€ 13,000,000
Luxembourg	€ 1,500,000	€ 1,700,000	€ 1,900,000	€ 3,000,000	€ 4,400,000	€ 900,000	€ 950,000
Netherlands	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Portugal	€ 100,000,000	€120,000,000	€ 28,000,000	€ 89,000,000	€130,000,000	€ 27,000,000	€ 24,000,000
Spain	€ 190,000,000	€220,000,000	€240,000,000	€ 380,000,000	€570,000,000	€120,000,000	€190,000,000
Sweden	€ 710,000	€ 710,000	€ 0	€ 14,000,000	€ 21,000,000	€ 3,500,000	€ 800,000
United Kingdom	€ 760,000,000	€880,000,000	160,000,000	€ 510,000,000	€770,000,000	€160,000,000	€200,000,000
EU15	1,800,000,000	2,000,000,000	580,000,000	1,800,000,000	2,700,000,000	520,000,000	€610,000,000
Bulgaria	€ 5,200,000	€ 6,600,000	€ 20,000,000	€ 7,100,000	€ 11,000,000	€ 5,900,000	€ 5,300,000
Cyprus	€ 730,000	€ 920,000	€ 2,800,000	€ 1,000,000	€ 1,500,000	€ 780,000	€ 760,000
Czech Republic	€ 8,600,000	€ 11,000,000	€ 34,000,000	€ 12,000,000	€ 19,000,000	€ 9,400,000	€ 6,000,000
Estonia	€ 1,500,000	€ 1,900,000	€ 5,800,000	€ 2,100,000	€ 3,100,000	€ 1,600,000	€ 1,300,000
Hungary	€ 6,400,000	€ 8,100,000	€ 24,000,000	€ 8,800,000	€ 13,000,000	€ 6,900,000	€ 4,200,000
Latvia	€ 1,800,000	€ 2,300,000	€ 6,800,000	€ 2,500,000	€ 3,700,000	€ 1,900,000	€ 1,700,000
Lithuania	€ 3,500,000	€ 4,400,000	€ 13,000,000	€ 4,700,000	€ 7,100,000	€ 3,600,000	€ 2,800,000
Malta	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Poland	€ 16,000,000	€ 21,000,000	€ 61,000,000	€ 22,000,000	€ 33,000,000	€ 17,000,000	€ 7,000,000
Romania	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Slovakia	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Slovenia	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
EU12	**€ 44,000,000**	**€ 56,000,000**	**€ 170,000,000**	**€ 61,000,000**	**€ 91,000,000**	**€ 47,000,000**	**€ 29,000,000**
EU27	**€ 1,900,000,000**	**€ 2,100,000,000**	**€ 750,000,000**	**€ 1,800,000,000**	**€ 2,800,000,000**	**€ 570,000,000**	**€ 640,000,000**

The main sources of uncertainty concern the following:

- Using generic data for each country on % of sludge that may fail (Table 31: % recycled sludge failing new limits on heavy metals in sludge under **Option 3**; Table 34: % recycled sludge which may fail the new limits on OCs under Option 3);

- Using assumptions on costs of further treatment based on % adjusted costs to reflect that not all sludges will need to be treated for heavy metals, OCs, and pathogens.

- Using costs that are not specific to individual countries or approaches commonly used in each country to deal with sludge (other than simple assumptions on percent failures in each country).

Your feedback will help us refine these assumptions, reducing uncertainty.

4.3.2 Environmental Impacts

The EFAR report (2007) concluded that global risk based on the results of the quantitative risk assessment was acceptable under the following:

- limits proposed under Annex III of the CEC (2003) communication;
- Bis(2-ethylhexyl) phthalate (DEHP) limit of 100mg/kg DM;
- Lower limit for lead of 500mg/kg DM (as opposed to 750 mg/kg).

This would suggest than when the limits are not set at this level, there could be potential benefits in terms of reduced environmental (and human health) risk. When national limits are more stringent and/or the quality of the sludge complies with such limits, the benefits in terms of health risk are expected to be negligible. The current limits on DEHP seem highly variable and appear to be unlinked to other substances. A European range is of .095 – 47mg/kg DS, median 7.2. Other limits include:

- UK – 0.3 – 1020, med 110
- Norway – 17 – 178, med 53
- N Rhine Westph – 0.93 – 110 med 22 90%ile 57.

Thus, there may be benefits from reducing DEHP however, there is no specific limit on this OC under Option 3 either; hence the benefits from this Option in terms of reduction in environmental (and human health) risk are uncertain.

The main environmental costs from this Option relate to the environmental impacts from the alternative routes of disposal. Assuming the above percentages of sludge going to the different routes, the impacts have been valued and are given in the following Table. Note that these include the human health costs from increases in quantities going to other disposal options.

The main sources of uncertainty with regard to the values below are as follows:

- Actual usage/type of landspreading not known, which may over or under-estimate additional externalities from moving to landfill or incineration.
- Distances that sludge would be transported under baseline option and Option 2 not known, suggesting these estimates are indicative of the potential costs.
- Some environmental costs are not included (as listed above).
- Some human health impacts may be captured within the costs.

Your feedback will help us refine these assumptions, reducing uncertainty.

Table 41: Environmental and Human Health Impacts from Option 3 incurred between 2010-2020 (PV costs)

Country	Environmental costs (to landfill)	Environmental costs (to incineration)
Austria	€ 0	€ 5,600,000
Belgium	€ 0	€ 2,100,000
Denmark	€ 0	€ 9,300,000
Finland	€ 0	€ 520,000
France	€ 6,300,000	€ 94,000,000
Germany	€ 0	€ 67,000,000
Greece	€ 0	€ 0
Ireland	€ 540,000	€ 8,000,000
Italy	€ 2,400,000	€ 35,000,000
Luxembourg	€ 110,000	€ 850,000
Netherlands	€ 0	€ 0
Portugal	€ 1,700,000	€ 25,000,000
Spain	€ 15,000,000	€ 110,000,000
Sweden	€ 0	€ 3,900,000
United Kingdom	€ 9,800,000	€ 150,000,000
EU15	€ 36,000,000	€ 510,000,000
Bulgaria	€ 1,200,000	€ 2,000,000
Cyprus	€ 170,000	€ 290,000
Czech Republic	€ 2,100,000	€ 3,600,000
Estonia	€ 350,000	€ 600,000
Hungary	€ 1,500,000	€ 2,500,000
Latvia	€ 410,000	€ 700,000
Lithuania	€ 790,000	€ 1,300,000
Malta	€ 0	€ 0
Poland	€ 3,700,000	€ 6,300,000
Romania	€ 0	€ 0
Slovakia	€ 0	€ 0
Slovenia	€ 0	€ 0
EU12	€ 10,000,000	€ 17,000,000
EU27	**€ 46,000,000**	**€ 530,000,000**

4.3.3 Social Impacts

The human health impacts from the alternative disposal options are included in the above estimates. Thus, they are only related to the externalities from alternative routes of disposal and not changes in risk from reduced/increased recycling.

There may be some benefits in terms of amenity and public perception. These are highly uncertain however. One other benefit from this Option is that it will help meeting some other legislation objectives, such as WFD objectives.

Under this Option however, there are a number of assumptions that will increase the uncertainty of estimates. These include:

- Actual usage/type of landspreading not known which may over or under-estimate additional externalities from moving to landfill or incineration;
- Distances that sludge would be transported under baseline option and Option 3 not known, suggesting these estimates are indicative of the potential costs.
- There will not be impacts on agricultural production as recycled sludge that will not meet the standards will be replaced by fertiliser, hence the impacts on employment will be limited.

Your feedback will help us refine these assumptions, reducing uncertainty.

4.4 Summary of Costs and Benefits and Distributional Impacts from Option 3

Impacts on MS from Option 3 are likely to arise from more stringent limits on heavy metals and inclusion of limits on organics and pathogens. The following Table presents the summary of economic, environmental and social costs for Option 3. According to the 2002 report, the total cost from Option 3 will be of around €1.2bn per year. Our estimates suggest annual costs of around €750 million to €890 million per year.

Table 42: Impacts from Option 3 incurred between 2010-2020 (PV costs)

Country	TOTAL/LOW ESTIMATE	TOTAL/HIGH ESTIMATE	% of EU-15 or EU-12	% of EU-27
Austria	€ 31,000,000	€ 41,000,000	1%	1%
Belgium	€ 18,000,000	€ 24,000,000	0%	0%
Denmark	€ 87,000,000	€ 110,000,000	2%	2%
Finland	€ 5,400,000	€ 6,800,000	0%	0%
France	€ 1,100,000,000	€ 1,300,000,000	18%	17%
Germany	€ 640,000,000	€ 760,000,000	11%	10%
Greece	€ 0	€ 0	0%	0%
Ireland	€ 100,000,000	€ 120,000,000	2%	2%
Italy	€ 390,000,000	€ 480,000,000	7%	7%
Luxembourg	€ 9,100,000	€ 11,000,000	0%	0%
Netherlands	€ 0	€ 0	0%	0%
Portugal	€ 300,000,000	€ 360,000,000	5%	5%
Spain	€ 1,200,000,000	€ 1,500,000,000	21%	20%
Sweden	€ 23,000,000	€ 30,000,000	0%	0%

Country	TOTAL/LOW ESTIMATE	TOTAL/HIGH ESTIMATE	% of EU-15 or EU-12	% of EU-27
United Kingdom	€ 1,900,000,000	€ 2,300,000,000	33%	31%
EU15	€ 5,900,000,000	€ 7,000,000,000	100%	94%
Bulgaria	€ 46,000,000	€ 51,000,000	12%	1%
Cyprus	€ 6,500,000	€ 7,200,000	2%	0%
Czech Republic	€ 76,000,000	€ 85,000,000	20%	1%
Estonia	€ 13,000,000	€ 15,000,000	4%	0%
Hungary	€ 54,000,000	€ 60,000,000	14%	1%
Latvia	€ 16,000,000	€ 17,000,000	4%	0%
Lithuania	€ 30,000,000	€ 33,000,000	8%	0%
Malta	€ 0	€ 0	0%	0%
Poland	€ 130,000,000	€ 150,000,000	36%	2%
Romania	€ 0	€ 0	0%	0%
Slovakia	€ 0	€ 0	0%	0%
Slovenia	€ 0	€ 0	0%	0%
EU12	**€ 380,000,000**	**€ 420,000,000**	100%	6%
EU27	**€ 6,300,000,000**	**€ 7,400,000,000**		100%

The Table also sets out the percentages of costs falling on the different MS according to their contribution to the total costs. As it can be seen, UK, Spain, France and Germany are the MS sporting the greatest costs. Of the new MS, Poland and the Czech Republic are bearing the greatest costs. The costs however do not include all cost types. There will be costs however to the regulatory authorities from changes to the legislation . Such costs will include:

iii. costs of consultation;
iv. administrative costs from changes to the national legislation.

These costs are unlikely to be significant however. Thus, the main stakeholders affected by the costs are:

- sludge producers: operators of sewage treatment works would have to upgrade and replace current treatment plant equipment in order to meet the new standards of treatment set out in the regulations and dispose of the sludge that will not be recycled;
- farmers: who are the sludge users, would have to comply with revised restrictions. Farmers would also have some additional costs for replacement inorganic fertilisers (or treated sludge) but there may be costs in terms of losses from agricultural production from the ban on use on vegetable crops, forage and land. These costs have not been quantified and your feedback on this is needed in order to estimate the costs.

The 2002 report also estimated €10/tDM for costs of pollution prevention supported by local authorities. These costs have been included within the further treatment costs but they represent less than 10% of the total treatment costs.

Environmental and social costs will accrue from increased incineration and landfill, as these will be the alternative routes for disposal to untreated sludge. These will accrue to all stakeholders. Environmental and social costs are estimated at 8-9% of the total impacts valued. As for the benefits from reduced recycling these are highly uncertain.

There may be some benefits in terms of amenity and public perception. These are highly uncertain however and have not been valued. One other benefit from this Option is that it will help meeting some other legislation objectives, such as WFD objectives. These have not been valued due to uncertainty.

Questions for the consultation

Q 19 – Do you agree with our assessment? If not, please expand. **Feel free to add comments on the benefits and costs from Option 3**

5 Option 4: total ban on the use of sludge on land

5.1 Overview of Option 4

Option 4 will consist of a total ban on the use of sludge on land.

The main issue with this Option relates to the increased demand for fertilisers due to the limitation to the use of sludge as such. This may put pressure on supply to satisfy demand.

Other risks from this Option relate to the impacts from the alternative means of disposal for sludge, amenity impacts from landfill and public health risk from incineration (i.e. air emissions) which may be worse than those stemming from the use of recycled sludge on land.

5.2 Assessment of Option

This Option will have significant implications in all MS, excluding parts of Austria (specifically two of its nine federal states) and the Netherlands (since there effectively is already a ban). The table below provides an overview of the impacts.

Table 43: Option 4 – overview of impacts considered and approach

Economic impacts	Stakeholder	Description	Quantified?
Costs of alternative disposal	Water and sludge management operators	As sludge recycled will be ended, there will be internal costs from its disposal	Yes
Policy implementation and control	Regulators	There will be costs from changing legislation and consultation (not monetised)	No
Benefits if meeting related legislation requirements (e.g. WFD)	Regulators	The total ban is likely to influence positively meeting the objectives of other legislation	No
Loss of use of sludge as a fertiliser and fertiliser replacement costs	Farmers	As sludge is no longer available, they will have to be replaced by fertiliser	Yes
Loss of agricultural output/crops	Farmers	There could be impacts on crops in the short term and depending on availability of fertiliser as a replacement.	No
Environmental impacts			
Environmental benefits from end to application	General public	Impacts on biodiversity, ecosystems, quality of water and groundwater from an end to application.	No
Benefits/costs from alternative routes of disposal including climate change	General public	Impacts from increase in use of landfill and incineration for sludge. Values include externalities from emissions (including energy recovery): air pollution as well as climate change impacts In the next stage of the impact assessment, further work could quantify certain impacts in greater detail (e.g. emissions of CO_2)	Partly
Social Impacts			
Human health benefits from end to application	General public	Owing to national practices and standards, benefits uncertain.	No
Human health from alternative routes of disposal	General public	Values include human health externalities from emissions (including energy recovery)	Yes

The main benefits relate to reduced risk to the environment and human health from application of sludge, but these will have to offset the costs of the alternative routes of disposal, which seems unlikely. There will be benefit from compliance with other legislation, such as the WFD. But these are very difficult to quantify due to uncertainty about the degree of implementation of relevant legislation at national level.

5.2.1 Assessment of economic impacts

Economic impacts from this option relate to:

- internal costs of alternative routes of disposal;
- fertiliser replacement costs and
- loss of agricultural output/crops.

These types of impacts are further elaborated below.

A ban on sludge application in agriculture would mean that all sewage sludge generated in the EU27 would have to be disposed of by means of incineration or landfilling. Table 44 below details the estimated alternative routes of sludge disposal in the various EU Member States.

Table 44: Impacts from Option 4 - disposal routes

Country	% of sludge failing going to incineration with energy recovery	% of sludge failing going to landfill
Austria Belgium Denmark Finland Sweden Germany Slovenia	100%	0%
France Ireland Italy Portugal United Kingdom	80%	20%
Greece Luxembourg Spain	60%	40%
Bulgaria Cyprus Czech republic Estonia Hungary Latvia Lithuania Malta Poland Romania Slovakia	30%	70%

As noted earlier, landfilling and incineration may be more costly disposal options than recycling. Based on the expected annual amounts of sewage sludge generated between 2010 and 2020 (as detailed in the Interim Report), it was possible to calculate the changes in sludge disposal flows and subsequently any changes in internal costs of sewage sludge disposal. This suggests that Option 4 would have an impact on costs incurred by sewage treatment companies, which may potentially be passed onto the consumer by means of a change in price of water supply and sewage disposal. The results are presented in Table 45 below.

Table 45: Changes in internal costs of sewage sludge disposal incurred between 2010 -2020(PV costs)

Member State	To landfill	To incineration (low)	To incineration (high)
Austria	€ 0	€ 65,000,000	€ 97,000,000
Belgium	€ 0	€ 17,000,000	€ 26,000,000
Denmark	€ 0	€ 110,000,000	€ 160,000,000
Finland	€ 0	€ 6,100,000	€ 9,200,000
France	€ 210,000,000	€ 1,100,000,000	€ 1,600,000,000
Germany	€ 0	€ 780,000,000	€ 1,200,000,000
Greece	€ 0	€ 0	€ 0
Ireland	€ 18,000,000	€ 89,000,000	€ 130,000,000
Italy	€ 56,000,000	€ 280,000,000	€ 430,000,000
Luxembourg	€ 2,700,000	€ 5,100,000	€ 7,600,000
Netherlands	€ 0	€ 0	€ 0
Portugal	€ 40,000,000	€ 200,000,000	€ 300,000,000
Spain	€ 340,000,000	€ 660,000,000	€ 980,000,000
Sweden	€ 0	€ 46,000,000	€ 69,000,000
United Kingdom	€ 230,000,000	€ 1,200,000,000	€ 1,800,000,000
EU15	€ 900,000,000	€ 4,500,000,000	€ 6,700,000,000
Bulgaria	€ 28,000,000	€ 15,000,000	€ 23,000,000
Cyprus	€ 3,900,000	€ 2,100,000	€ 3,200,000
Czech Republic	€ 49,000,000	€ 27,000,000	€ 40,000,000
Estonia	€ 8,300,000	€ 4,500,000	€ 6,700,000
Hungary	€ 35,000,000	€ 19,000,000	€ 28,000,000
Latvia	€ 9,700,000	€ 5,300,000	€ 7,900,000
Lithuania	€ 19,000,000	€ 10,000,000	€ 15,000,000
Malta	€ 0	€ 0	€ 0
Poland	€ 88,000,000	€ 48,000,000	€ 71,000,000
Romania	€ 0	€ 0	€ 0
Slovakia	€ 0	€ 0	€ 0
Slovenia	€ 0	€ 0	€ 0
EU12	**€ 240,000,000**	**€ 130,000,000**	**€ 200,000,000**
EU27	**€ 1,100,000,000**	**€ 4,600,000,000**	**€ 6,900,000,000**

While it is clear that some farmers will seek to substitute sewage sludge with increased use of fertilisers, it is not possible to reliably determine how prevalent this strategy will be. A major limiting factor hindering an increased take-up of fertilisers would be the capacity of the fertiliser industry to increase its production capacity. The following estimates of fertiliser replacement costs are based on the assumption that all sludge will be replaced by fertiliser.

Table 46: Fertiliser replacement costs between 2010-2020 (€PV)

Country	Fertiliser replacement costs
Austria	€ 4,800,000
Belgium	€ 580,000
Denmark	€ 26,000,000
Finland	€ 76,000
France	€ 380,000,000
Germany	€ 94,000,000
Greece	€ 0
Ireland	€ 29,000,000
Italy	€ 26,000,000
Luxembourg	€ 1,500,000
Netherlands	€ 0
Portugal	€ 48,000,000
Spain	€ 290,000,000
Sweden	€ 2,700,000
United Kingdom	€ 410,000,000
EU15	€ 1,300,000,000
Bulgaria	€ 8,400,000
Cyprus	€ 1,200,000
Czech Republic	€ 9,600,000
Estonia	€ 2,100,000
Hungary	€ 6,700,000
Latvia	€ 2,700,000
Lithuania	€ 4,500,000
Malta	€ 0
Poland	€ 11,000,000
Romania	€ 0
Slovakia	€ 0
Slovenia	€ 0
EU12	€ 46,000,000
EU27	€ 1,400,000,000

The impacts associated with a potential reduction in agricultural output or even with a reduction in the area of agricultural land again depend on the availability of fertilisers and on the capacity of farmers to employ alternative coping strategies including a change in farming practices. **Under this Option, we have not estimated these impacts, so your input will be valuable.**

5.2.2 Assessment of environmental impacts

The main environmental impacts from this Option relate to changes in sludge disposal routes and to any benefits to the environment from reduced use of sludge in agriculture. As noted above, in the vast majority of EU Member States, Option 4 would result in significant increases in sludge incinerated and/or landfilled. As each of the disposal routes is associated with varying external costs environmental costs stemming from sludge disposal under Option 4 would be significantly different from those taking place under Option 1. Environmental costs associated with Option 4 are detailed in Table 47 below (please note that these data are based on estimations from Sede & Andersen 2003 and they include human health impacts due to transportation).

Table 47: Environmental costs of Option 4 (2010-2020)

Country	Environmental costs (to landfill)	Environmental costs (to incineration)	Total environmental costs
Austria	€ 0	€ 19,000,000	€ 19,000,000
Belgium	€ 0	€ 5,000,000	€ 5,000,000
Denmark	€ 0	€ 31,000,000	€ 31,000,000
Finland	€ 0	€ 1,700,000	€ 1,700,000
France	€ 13,000,000	€ 300,000,000	€ 313,000,000
Germany	€ 0	€ 220,000,000	€ 220,000,000
Greece	€ 0	€ 0	€ 0
Ireland	€ 1,100,000	€ 26,000,000	€ 27,100,000
Italy	€ 3,400,000	€ 81,000,000	€ 84,400,000
Luxembourg	€ 160,000	€ 1,500,000	€ 1,660,000
Netherlands	€ 0	€ 0	€ 0
Portugal	€ 2,400,000	€ 58,000,000	€ 60,400,000
Spain	€ 21,000,000	€ 190,000,000	€ 211,000,000
Sweden	€ 0	€ 13,000,000	€ 13,000,000
United Kingdom	€ 14,000,000	€ 340,000,000	€ 354,000,000
EU15	**€ 55,000,000**	**€ 1,300,000,000**	**€ 1,355,000,000**
Bulgaria	€ 1,700,000	€ 4,300,000	€ 6,000,000
Cyprus	€ 240,000	€ 610,000	€ 850,000
Czech Republic	€ 3,000,000	€ 7,600,000	€ 10,600,000
Estonia	€ 500,000	€ 1,300,000	€ 1,800,000
Hungary	€ 2,100,000	€ 5,400,000	€ 7,500,000
Latvia	€ 590,000	€ 1,500,000	€ 2,090,000
Lithuania	€ 1,100,000	€ 2,900,000	€ 4,000,000
Malta	€ 0	€ 0	€ 0
Poland	€ 5,300,000	€ 14,000,000	€ 19,300,000
Romania	€ 0	€ 0	€ 0
Slovakia	€ 0	€ 0	€ 0
Slovenia	€ 0	€ 0	€ 0
EU12	**€ 15,000,000**	**€ 37,000,000**	**€ 52,000,000**
EU27	**€ 69,000,000**	**€ 1,300,000,000**	**€ 1,369,000,000**

5.2.3 Assessment of social impacts

As before, there will be social impacts associated with the human health impacts stemming from the alternative disposal routes. These have been included in the above values however.

The benefits from reduced application of sludge on agricultural land however are highly uncertain and have not been valued. This is because, as revealed during the first consultation, there is limited evidence of contamination through the use of sludge on land on humans.

Although there will be benefits in terms of amenity and consumer confidence, these impacts are very difficult to value.

5.3 Summary of Costs and Benefits and Distributional Impacts from Option 4

This Option is likely to have significant impacts on the different MS. The main costs associated with this option will be related to:

- fertiliser replacement costs;
- change in agricultural produce (and possible loss of agricultural land, especially when fertiliser demand is unlikely to be met by producers of fertilisers);
- environmental costs from increased incineration and recycling (i.e. from transport and emissions); and
- human health impacts derived from the above (increased incineration and landfill).

The total costs estimated in the CBA report , (Andersen & Sede 2002), for the scenario where no sludge is able to meet the new regulatory requirements could be seen as a surrogate of this Option, i.e. as corresponding to a ban on the use of sludge on agricultural land. This scenario led to costs of 1.2bn/year for the 15 MS of the European Union and was related to a total sludge quantity of 4,893ktDM/year. Our PV estimates are given below. The annualised costs are estimated to range from €1.1bn to €1.3bn. So these are of similar order of magnitude.

Table 48: Total PV costs of Option 4 (2010 – 2020)

Country	High	Low	% of EU-27- low estimate	% of EU-27 – high estimate
Austria	€ 98,000,000	€ 130,000,000	1%	1%
Belgium	€ 26,000,000	€ 34,000,000	0%	0%
Denmark	€ 180,000,000	€ 240,000,000	2%	2%
Finland	€ 8,900,000	€ 12,000,000	0%	0%
France	€ 2,200,000,000	€ 2,700,000,000	24%	23%
Germany	€ 1,200,000,000	€ 1,600,000,000	14%	14%
Greece	€ 0	€ 0	0%	0%
Ireland	€ 180,000,000	€ 220,000,000	2%	2%
Italy	€ 500,000,000	€ 650,000,000	6%	5%
Luxembourg	€ 12,000,000	€ 15,000,000	0%	0%
Netherlands	€ 0	€ 0	0%	0%
Portugal	€ 390,000,000	€ 490,000,000	4%	4%
Spain	€ 1,700,000,000	€ 2,000,000,000	18%	17%
Sweden	€ 69,000,000	€ 92,000,000	1%	1%
United Kingdom	€ 2,400,000,000	€ 3,000,000,000	27%	25%

Country	High	Low	% of EU-27- low estimate	% of EU-27 – high estimate
EU15	€ 8,900,000,000	€ 11,000,000,000	100%	95%
Bulgaria	€ 66,000,000	€ 73,000,000	12%	1%
Cyprus	€ 9,300,000	€ 10,000,000	2%	0%
Czech Republic	€ 110,000,000	€ 120,000,000	20%	1%
Estonia	€ 19,000,000	€ 21,000,000	4%	0%
Hungary	€ 77,000,000	€ 87,000,000	14%	1%
Latvia	€ 22,000,000	€ 25,000,000	4%	0%
Lithuania	€ 42,000,000	€ 47,000,000	8%	0%
Malta	€ 0	€ 0	0%	0%
Poland	€ 190,000,000	€ 210,000,000	36%	2%
Romania	€ 0	€ 0	0%	0%
Slovakia	€ 0	€ 0	0%	0%
Slovenia	€ 0	€ 0	0%	0%
EU12	€ 540,000,000	€ 600,000,000	100%	5%
EU27	€ 9,400,000,000	€ 12,000,000,000		100%

Another study calculated the value of sewage sludge in the EU to range from 0.5% to 1% of the total agricultural budget in the EU[20] (used to substitute mineral fertiliser). The agricultural budget for the EU in 2009 is €116bn. This would imply that the value of sludge is of around €0.58bn to €1.16bn per year. This is not very far off the estimate produced here.

The distribution of costs seems to indicate that France, Germany, United Kingdom and Spain will be the ones bearing the highest costs. As for the distribution of costs among stakeholders, the greatest cost will be for the water and waste management operators that will have to dispose of sludge through different routes (around 70% of the total costs). The rest of the costs will be similarly split among farmers and the general public. The costs to the regulatory authorities of changing the legislation, in terms of administration, have however not been quantified.

Please feel free to add comments on the benefits and costs from Option 4

[20] Kroiss H and Zessner M (2007): Ecological and Economical Relevance of Sludge Treatment and Disposal Options, Institute for Water Quality and Waste Management at Vienna University of Technology, Austria.

6 Option 5: Repeal of the Directive

6.1 Overview of Option

Option 5 will involve repealing the Directive.

6.2 Impacts from this Option

The impacts of this option will depend on two main issues: first, how Member States react and in particular whether they might change national legislation governing sewage sludge; and second, the extent to which other EC legislation might govern the sludge disposal and in particular the spreading of sludge on land. The future actions of the Member States in this situation in particular are difficult to predict.

6.2.1 Actions of Member States

As noted above, it is quite difficult to predict the actions of Member States were the Sewage Sludge Directive to be repealed. On the one hand, Member States with national legislation that is currently more stringent than the directive might keep this in place. However, Member States would also be free to remove all restrictions on sludge disposal (within the restrictions of other EC legislation).

Under this Option, however, we could assume that the national legislation will remain in place especially in the short term but changes may be introduced in the future. The greatest issue however is that in the case that some Member States lift all restrictions on sludge disposal. In this case, people could just apply sludge how and when they wanted (in line with national requirements). This may not guarantee a standard level of protection across all MS.

6.2.2 Influence of other EC legislation

Without the Sewage Sludge Directive in place, other EC legislation might influence the spreading of sludge on land. The following table presents an overview of other environmental protection legislation that might influence the spreading of sludge. (Note that such drivers also apply to the baseline scenario).

Table 49: Current EC environmental legislation that might influence the spreading of sludge on land if Directive 86/278/EEC were to be repealed

Directive	Potential influence
Directive 91/676/EEC – Nitrates Directive	• Fertilizer application limited in nitrate vulnerable zones; also affects sludge application • No influence on other pollutants
Council Regulation (EC) No 834/2007 on organic production and labelling of organic products	• No clear ban on organic labelling of sewage sludge, but Member State practices generally do not accept sewage sludge as organic • As organic production is a small share of all agriculture, any effects from this Regulation or Member State requirements likely to be negligible overall; perhaps some influence in restricted local areas
EC Decisions 2006/799 and 2007/64 on criteria for the award of a Community eco-label to growing media	• Growing media containing sludge shall not be awarded an eco-label • Same as above: likely to have negligible or mainly local effects
Environmental Liability Directive 2004/35/EC	• Environmental liability requirements may encourage private operators to use good practice for sludge disposal – not all operators, however, may do so
Directive 2003/87/EC on greenhouse gas emissions	• Possible impact on ammonia production
Directive 2006/118/EC –	• May influence spreading of sludge in local areas where

groundwater protection against pollution and groundwater quality standards	groundwater exceeds quality standards
Directive 2008/105/EC – EQS for pollutants to achieve good surface water quality	• May influence spreading of sludge in local areas where surface waters exceed quality standards

The initial analysis suggests that these pieces of legislation may have some influence on the spreading of sewage sludge. However, they will influence only specific pollutants (the case for the Nitrates Directive) or local areas, for example where groundwater or surface water quality does not meet standards. While the Liability Directive might have a more broad-based influence, it may not affect all operators.

The European Commission's proposal for a Framework Soils Directive (COM(2006) 232) may have a more far-reaching effect. This proposal remains under discussion, however, and in the face of this uncertainty it has not been assessed.

A further question is whether EC food safety legislation would protect human health from indirect exposure, e.g. from fruits and vegetables grown using sewage sludge. Here, a broad and integrated framework of legislation has been put in place to ensure food safety (the framework is provided by Regulation (EC)178/2002 laying down the General Principles and requirements of Food Law). It is not clear, however, if this legislation and its implementation currently addresses potential risks from the spreading of sewage to land, as these are covered by the Sewage Sludge Directive. The repeal of this directive might require an adjustment of food safety legislation and its implementation in order to ensure adequate protection of human health.

6.3 Assessment of Option

6.3.1 Assessment of economic impacts

The marginal costs of this Option against the baseline are negligible.

The benefits will be in terms of costs savings from current monitoring, sampling and analysis accruing to the regulatory authorities. However, it is not certain that MS will change their regulation and practices. Indeed, it is unlikely that repeal of the Directive will lead to the adoption of less stringent quality standards for sludge in national legislation, especially in the short term. This is based on the results of the first consultation. So savings may not be large.

It is important to identify that such option may affect trade among MS depending on consumers' perception of risk from different products. Competitiveness and competition may be affected at EU level too; operators of wastewater treatment plants across the EU might find much greater divergences among Member State requirements than at present. While in some Member States they might realise savings, in others they would not. This could indicate significant distributional impacts.

6.3.2 Assessment of environmental and social impacts

In a worst-case scenario, a country could remove all restrictions on the spreading of sludge. This might create actual health impacts from contamination of food, and while sludge is not traded among Member States, food is, making this a risk for the EU as a whole. The question is: does EU food safety legislation provide adequate safeguards against such an event?

In addition, as highlighted above, consumer perception and confidence are likely to play a key role on the social impacts (and likely macro-economic impacts) from this Option. During the first consultation, some

respondents strongly opposed the application of sewage sludge to land for precautionary reasons. If the directive is repealed, the question of whether other EU legislation provides adequate protection for human health and the environment will be subject to the interpretation of the consumers. It is unlikely that consumers will have enough information to make a proper assessment on this.

6.4 Summary of Costs and Benefits from Option 5

This preliminary review thus suggests that other EC environmental legislation would not provide sufficient protection of the environment in the event that Directive 86/278/EEC were to be repealed; nor would other legislation provide sufficient protection of human health from direct impacts of sewage sludge spread on land.

This tentative conclusion would appear to make this option unacceptable.

The analysis in this draft is brief and will be expanded in the final version of this paper. It should be noted, however, that none of the respondents to the first consultation called for a repeal of the directive, nor were arguments made concerning overlaps between the directive and other EC legislation. Indeed, several respondents called for a tightening of the Directive's current requirements, and some even a total ban on sewage sludge to land for precautionary reasons. As it can be seen in Section 1.2 Impact Screening, the impacts from this Option are highly uncertain.

It will be valuable to receive input on this option, and in particular on the tentative conclusion that it is not acceptable as it cannot guarantee protection of the environment. If Member State and stakeholder respondents by and large agree with this analysis, a full impact assessment of this option would not be warranted.

7 Comparison of Options

This Section presents a summary of the assessment, based on the assumptions presented above. The aim of the consultation will be to refine our assumptions, so your input to our questions will be highly appreciated.

An Impact screening has been undertaken on the different options according to the EC Impact Assessment Guidelines. The most important impacts have been carried forward for a detailed assessment. The following Table sets out a first assessment of the Options in qualitative terms.

Table 50: Initial qualitative assessment

Option	Economic Impacts	Environmental Impacts	Social Impacts
Option 1 - Baseline Scenario	0	0	0
Option 2 – "moderate changes"	Costs of alternative disposal (-) Obligation of treatment (-) Pollution prevention costs (?) Policy implementation and control Changes to regulation: including costs of consultation (-) Pollution prevention costs Benefits if meeting other related legislation requirements (i.e. WFD) (+) Loss of use of sludge as a fertiliser and fertiliser replacement costs (-) Loss of agr. output/crops (?)	Environmental benefits from reduced application (?/+) Environmental benefits/costs from alternative routes of disposal including climate change impacts from incineration, landfilling (?/-)	Human health benefits from reduced application (?/+) Human health costs from alternative routes of disposal, e.g. air pollution from incineration (?/-)
Option 3 – more significant changes	As above but greater in magnitude		
Option 4 - Total Ban	Fertiliser replacement costs (--) Alternative routes of disposal for all sludge arisings (--) Loss of agricultural output/crops (-/?)	Environmental benefits from reduced application (?/+) Environmental benefits/costs from alternative routes of disposal including climate change impacts (--)	Human health benefits from reduced application (?/+) Human health from alternative routes of disposal including climate change impacts (--) Amenity impacts from increased landfilling (--)
Option 5 - Repeal of the Directive	Benefits from reduced policy monitoring and compliance (+)	Environmental benefits/costs from alternative routes of disposal including climate change (?) Potential environmental risks if a MS abandons all sludge regulation (?/--)	Human health from alternative routes of disposal including climate change (?) Potential risks to human health if a MS abandons all sludge regulation (?/--)_ Amenity impacts from increased landfilling (?)
0: impact expected to be negligible; - : low/moderate negative impacts expected --: significant negative impacts expected +: low/moderate positive impacts ++: significant impacts expected			

The greatest costs are expected from Option 4, the total ban. The repeal of the Directive could imply savings to the regulators; but the costs from these Options may not outweigh the benefits. Option 2 is unlikely to have significant costs implications. Option 3 is likely to affect a significant numbers of sewage treatment plants. Table 51 presents our preliminary estimates of costs for the different Options.

Table 51: Summary - Initial quantitative assessment (€m)

	Economic		**Environmental/Human health**
option	Low	High	
Present Value costs			
Option 1 – Baseline (no change)	n/a		
Option 2 – Moderate changes	2,470	2,940	243
Option 3 – More significant changes	5,660	6,860	576
Option 4 – Total ban	7,100	9,400	1,369
Option 5 – Repeal of Directive	Non estimated		
Annualised costs			
Option 1 – Baseline (no change)	n/a		
Option 2 – Moderate changes	295	352	29
Option 3 – More significant changes	677	821	69
Option 4 – Total ban	849	1,124	164
Option 5 – Repeal of Directive	Non estimated		

The above estimates do not include all impacts however. Importantly, the benefits to the environment and human health from changing the standards and reducing application of sludge to land have not been quantified. This is because the impacts from this are highly uncertain however. There may be benefits from reducing DEHP however, this Organic Compound (OC) is not addressed under Option 2 and no specific limits are proposed under Option 3. This also holds for the limit on lead, as Option 2 limit is lower than that proposed under EFAR (2007). Under Option 3, the limit on lead will be more stringent so the cost from this Option may be an over-estimate. The environmental and human health impacts have been quantified with regard to the emissions from the alternative routes of disposal and transport impacts.

There may be additional benefits in terms of amenity and public perception. These are highly uncertain however. One other benefit from Option 2 and 3 is that it will help meeting some other legislation objectives, such as WFD objectives. These have not been quantified however as it will depend on the degree of implementation of the different legislation at national level and information on this is limited.

Questions for the consultation

Q 20: Do you have any comments on the Options as proposed, in particular in terms of their expected impacts?

Q 21: Do you agree with our cost data and assumption presented in this report and the overall estimates presented in Table 51? Please expand, providing us with your data and estimates if possible.

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Annex 1: Limits considered under the different reports

The limits assessed in 2002 are given in the next Tables for comparison purposes. As it can be seen from the Annex, the short term limits on PTE are equivalent to the limits proposed under Option 2 of this IA, whereas the 2002 proposed values for the long-term are closer to those of Option 3 under this IA.

Table 52: Comparison of limit values of heavy metals in sludge in the various reports (mg/kg)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
BASELINE: Directive 86/278/EEC	20-40	*	1000-1750	16-25	300-400	750-1200	2500-4000
Andersen and Sede (2002)- short term	10	1000	1000	10	300	750	2500
Andersen and Sede (2002)- mid term	5	800	800	5	200	500	2000
Andersen and Sede (2002)- long term	2	600	600	2	100	200	1500
2009 Option 2	**10**	**1000**	**1000**	**10**	**300**	**750**	**2500**
2009 Option 3	**5**	**150**	**400**	**5**	**50**	**250**	**600**
*: The consolidated version dated April 2009 does not contain a limit for chromium. Annex 1B notes that the Council will fix the limit on the basis of the proposals submitted to the Directive. To our knowledge there has not been recent discussion on this.							

Table 53: Comparison of limit values of heavy metals in soil

	BASELINE 86/278/EEC		**Option 2**		**Option 3**		**Andersen and Sede (2002)**	
PTE/pH	**(6<pH<7)**	**5≤pH<6**	**6<pH<7**	**pH≥7**	**5≤pH<6**	**6<pH<7**	**pH≥7**	**6<pH<7**
Cd	1-3	0.5	1	1.5	0.5	1	1.5	1
Cr	-	50	75	100	50	75	100	60
Cu	50-140	30	50	100	30	50	100	50
Hg	1-1.5	0.1	0.5	1	0.1	0.5	1	0.5
Ni	30-75	30	50	70	30	50	70	50
Pb	50-300	70	70	100	70	70	100	70
Zn	150-300	100	150	200	20	20	200	150

Table 54: Comparison of limit values of OC

	Bis(2-ethylhexyl) phthalate (DEHP)	**Linear Alkylbenzene Sulfonate (LAS)[a]**	**Nonylphenol/Nonylphenol ethoxylate (NP/NPE)**	**Polycyclic aromatic hydrocarbon (PAH)**	**Polychlorinated biphenyls (PCB)[b]**	**Dioxins/Furans (PCDD/F)**
Directive 86/278/EEC	-	-	-	-	-	-
Andersen and Sede (2002)	100	2600	50	6	0.8	100
Option 2	-	-	-	6	0.8	-
Option 3	-	5000	450	6	0.8	100
Notes: a) sum of 9 congeners: acenapthene, fluorene, phenanthrene, fluoranthene, pyrene, benzo(b+j+k)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene, indeno(1,2,3-c,d)pyrene b) sum of 7 congeners: PCB 28, 52, 101, 118, 138, 153, 180						

Annex 2: Approach to the Assessment of different Impacts

1 Assessment of Economic Impacts

As seen in Section 1 (Table 5), most of the quantifiable impacts from the different options will fall under the category of economic costs. The direct economic costs from the options are expected to arise in relation to:

- Costs of alternative routes of disposal for sludge failing the standards to be recycled;
- Pollution prevention costs in order to improve quality and recycling;
- Obligation of treatment;
- Quality assurance on recycled sludge ; and
- Fertiliser replacement costs or loss of agricultural produce (should there be limits to the amount of fertiliser used or no full replacement).

There may also be some indirect economic impacts. These include for instance the uplift in value of land from reduced sludge application. Some of these benefits, as noted earlier, are highly uncertain, such as benefits to food retailers linked with consumer demand.

1.1 Costs of alternative routes of disposal

Where sludge fails the new limits under the Options, the alternative to treating the sludge is to dispose of this by some other means. This will have costs implications, although the total costs will depend on both the amount of sludge to be disposed and the costs of alternative disposal.

The costs for incineration, landfill disposal and sludge application to land were discussed in Andersen and Sede (2002) and are replicated below (here updated to 2009 values). Consultation for our earlier report however has highlighted that the disposal costs may be higher than those given in the Table.

Table 55: Total costs of different sludge routes (in €/t DM)

	Landspreading of semisolids	Landspreading of semisolid digested	Landspreading of solid	Landspreading of composted	Landfilling	Co-incineration	Mono-incineration
Internal costs (investment and operational costs)	198	198	255	374	308	298	384

Moreover, as reported in Andersen and Sede, incinerators may be designed with an extra standby capacity, in order to be able to incinerate even during periods of heavy maintenance (usually one month per year) and costs are very sensitive to this parameter - in the case of a 100% extra capacity, the cost of incineration would increase by almost 50% (+169 Euro/tDM), due to the high investment costs. The variability of costs for incinerators is reflected in the Table 56.

Table 56: Costs of incineration

Capital, €k/tRwDS/d	Operating for 15tRwDS/d, €k/year	Costs (€/tRwDS)
667 – 1334	667 – 1067	87

To estimate these impacts, assumptions are needed for the amount of sludge affected by the changes under each Option and which has to go to different disposal options (% increase/decrease) compared with the baseline for the different MS affected.

1.2 Pollution prevention costs

MS may wish to undertake pollution prevention measures at source in order to improve the quality of the sludge and comply with the new limits. These could include a variety of measures ranging from better information on sources at local level to process reformulation and industrial on-site pre treatment. Example measures are provided in Table 57. The costs and range of stakeholders supporting such costs will vary according to measure. Because of this, it is difficult to predict with accuracy at MS level the costs of pollution prevention.

Table 57: Example measures of pollution prevention

Improve knowledge and information on sources on local level
Regulatory, economic, voluntary and educational measures or instrument
Reduction of pollutant loads in the sewer
Proper disposal of household waste
Product re-formulation
Eco-labelling
Voluntary collection schemes (liquid waste)
Industrial pre-treatment of water on-site

The 2002 assessment estimated costs for reduction of heavy metals loads of around €240/tDM. As no data were found on organic compounds the same costs figure was used. Pollution prevention for pathogens was not deemed feasible, so no costs estimate was used. Neither was the cost of removing metals in soil estimated, due to technical aspects.

The costs for local authorities of pollution prevention were estimated at €12/tDM, based on one FTE for identifying the sources of pollution, negotiating conventions and controlling industrial discharges for a large waste water treatment plant.

To estimate these impacts in monetary terms, estimates are needed on the amount of sludge affected for the MS affected by the different Options.

1.3 Obligation of treatment

Some MS will have to treat the sludge to higher standards in order to meet the new limits on pathogens. The total costs will depend not only on the type of treatment but also on the percentage of sludge that will have to be treated. The types of treatment considered for this IA are described in the following Table.

Table 58: Advanced treatments (CEC, 2003)

Type of advanced treatment	Description of process
Windrow composting	All material maintains a temperature of at least 55°C for at least four hours between each turning. The heaps shall be turned at least three times and in any case a complete stabilisation of the material shall be reached. The costs of sludge composting in Germany are between 100 and 200 €/Mg of dry matter for windrow composting[21]
In-vessel composting	All material maintains a temperature of at least 55°C for at least four hours and reaches complete stabilisation.
Thermal drying	Temperature of the sludge particles reaches at least 80°C for ten minutes and moisture content reduced to less than 10%.
Thermophilic aerobic or anaerobic stabilisation	Temperature of at least 55°C for a continuous period of at least four hours after the last feed and before the next withdrawal. Plant should be designed to operate at a temperature of at least 55°C with a mean retention period sufficient to stabilise the sludge.
Thermal treatment of liquid sludge	For a minimum of ten minutes at 80°C or 20 minutes at 75°C or 30 minutes at 70°C followed by mesophilic anaerobic digestion at a temperature of 35°C with a mean retention period of 12 days
Conditioning with quicklime (CaO)	Reaching a pH of at least 12.6 or more and maintaining a temperature of at least 55°C for two hours. The sludge and lime shall be thoroughly mixed.

However, there is limited information as to the costs of such treatment, especially due to the variability of costs among MS. Some information on costs is presented in the next Table.

Table 59: Advanced treatment Costs

Type of advanced treatment	Capital, €k/tRwDS/d	Operating for 15tRwDS/d, €k/year	Costs (€/tRwDS)
Pre-pasteurisation + digestion	667 - 935	400 – 534 (less energy income)	74 – 93 (less energy income)
Drier to agriculture	400	667 – 801	134
Lime treatment	80 - 200	467 – 1067	80

In order to estimate these impacts in monetary terms, estimates are needed on the amount of sludge to be treated by the MS affected by the different Options as well as the preferred treatment option. As data were not available on the preferred treatment option, the uncertainty over which methods would be used is taken into account by using a low cost (€74/tRwDS) and a high cost (€134/tRwDS).

[21] Martin Kraner, Gerold Hafner, Ingrid Berkner, Ertugrul Erdin (2008) Compost from sewage sludge – a product with quality assurance system.

1.4 Quality assurance

Quality assurance system costs were estimated by Andersen and Sede (2002) at €18/tDM.

To estimate these impacts in monetary terms, estimates are needed on the amount of sludge to be quality assured. To give worst case costs, it has been assumed that all sludge passing the standards and recycled would incur quality assurance costs.

1.5 Fertiliser replacement costs and changes in crop yield

Scientific literature reports that excessive levels of metals in soil could harm crops. However, current limitations concerning metal levels in sludge and soil avoid the occurrence of levels high enough to provoke such phytotoxicity phenomena, and no decrease in yield following sludge application has yet been described in the scientific literature, when complying with agricultural good practices. On the contrary, sludge is used for the nutrients it provides to soil and crop, leading to a yield improvement. Moreover, metals are also present in mineral fertilisers usually applied on agricultural soils. Should there be a limit on the availability of fertiliser as a replacement there could be impacts on crop volumes. The costs and benefits related to fertiliser replacement are given in the next Table.

Table 60: Total benefits (internal) of sludge routes (in €/t DM)

	Landspreading of semisolids	Landspreading of semisolid digested	Landspreading of solid	Landspreading of composted	Landfilling	Co-incineration	Mono-incineration
Internal benefits (savings in fertiliser)	-65	-65	-65	-94	0	0	0

The costs associated with having to replace sludge with fertiliser are based on the proportion of sludge that is no longer landspread. This is the same volume as would have to be disposed of through an alternative route (it is assumed that sludge sent for further treatment could subsequently be spread on land, where this is currently the practice).

1.6 Other economic impacts

Other impacts are expected to arise in terms of:

- Benefits to food retailers linked to consumers' increased demand;
- Uplift in value of land from reduced risk; and
- Impacts from additional condition on application.

The loss of value of agricultural land was reported in 2002 at €2,500 to €25,000/ha however such impacts were not valued in 2002 on the basis of variability of practices and baseline considerations concerning quality of land. We believe that these impacts are highly uncertain and should not be included in the analysis of impacts in quantitative form. Similarly, the benefits to food retailers due to increased demand are highly uncertain so these impacts have not been included further.

The costs to farmers from conditions on application will need to be included. Costs of recycling to land routes are very sensitive to the type and duration of storage that is necessary when landspreading is directly not possible (especially in winter):

- if the storage (9 months) was not necessary for land use routes, costs of the landspreading routes could decrease significantly by more than 30% (-€60/tDM),
- on the contrary, if storage has to be more sophisticated (cover, odour treatment), costs of these routes could increase by 30% (€60/tDM).

The first will represent a saving when conditions on application are less stringent and/or are ceased, i.e. repeal of the legislation. On the other hand, if conditions are made more stringent, the costs to farmers will increase. To be included, estimates are needed of the volume of sludge affected.

Other indirect benefits relate to other related legislation, as more stringent objectives may help meeting other Directive's objectives, for instance the WFD.

Other economic impacts include the loss of the development of products from sewage sludge. This however continues to be explored. The complex technologies and operational costs required to extract or produce products from sewage sludge continue to be less cost efficient in comparison to the traditional, proven options such as recycling to land, incineration, and landfilling. Thus, these impacts are not included in the valuation exercise.

2 Assessment of Environmental Impacts

The main environmental impacts will relate to the following:

- Direct environmental impacts: changes in environmental risk from changes in application of sludge on land; and
- Indirect environmental impacts: changes in environmental risk from alternative disposal routes. The sludge failing standards will have to be either treated and/or disposed by other routes. The costs for incineration, landfill disposal and sludge application to land were discussed in Andersen and Sede (2002) and are replicated below. Consultation for our earlier report however has highlighted that the disposal costs may be higher than those given in the Table.

2.1 Direct environmental impacts

A number of impacts may arise from changes in application of sludge to land. These include:

- Livestock health: should the recycling of sludge to land be reduced, livestock may have reduced exposure to pollutants and pathogens;
- Ecosystems degradation: reduced risk from contamination by heavy metals and organic pollutants release into the environment;
- Climate change: this impact relates to transportation of sludge from where the sludge will be applied to where it would be disposed;
- Soil micro-organisms reduction: this is particularly due to the reduced concentration of heavy metals in soil when limits are more stringent;
- Buildings degradation: mainly due to transportation;
- Decrease/increase in surface water quality from changes in risk of leaching following run-off; and
- Decrease/increase in groundwater quality from leaching from changes in risk of leaching following run-off, especially from nitrates.

Although there are methodologies to quantify these benefits (e.g. replacement costs, hedonic pricing) these direct impacts will be difficult to quantify, mainly due to two reasons:

- there is no evidence of significant environmental risk due to recycling of sludge to land based on current practices, as revealed by the earlier consultation; and
- the environmental impacts from fertilisers used to replace sludge will be similar thus offsetting the benefits/costs.

The EFAR report (2007) concluded that global risk based on the results of the quantitative risk assessment was acceptable under the following:

- limits proposed under Annex III of the CEC (2003) communication;
- DEHP limit of 100mg/kg DM; and
- Lower limit for lead of 500mg/kg DM (as opposed to 750 mg/kg).

This would suggest than when the limits are not set at this level, there could be limited benefits in terms of reduced health risk. When national limits are more stringent and/or the quality of the sludge complies with such limits, the benefits in terms of health risk are expected to be negligible. The current limits on DEHP seem highly variable and appear to be unlinked to other substances. A European range is of 0.095 to 47mg/kg DS, median 7.2 mg/kg. Other limits include:

- UK: 0.3 to 1020 mg/kg with median of 110 mg/kg;
- Norway: 17 to 178 mg/kg with median of 53 mg/kg; and
- N Rhine: 0.93 to 110 mg/kg with median of 22 mg/kg and 90%ile of 57 mg/kg.

Thus, there may be benefits from reducing DEHP however, this Organic Compound (OC) is not addressed under Option 2 and no specific limits are proposed under Option 3. This also holds for the limit on lead, as Option 2 limit is lower than that proposed under EFAR (2007). Under Option 3, the limit on lead will be more stringent so the cost from this Option may be an over-estimate.

Because of the above reasons, we believe that some of these impacts are difficult to quantify, in other words there is limited evidence and/or the impacts are expected to be limited for the following impact categories:

- Livestock health;
- Ecosystems degradation;
- Soil micro-organisms reduction;
- Decrease/increase in surface water quality; and
- Decrease/increase in groundwater quality.

The external cost in terms of building degradation and climate change were estimated in Sede & Andersen but these were variable according to the type of sludge being applied. The values are reported in the next table. As can be seen, the cost will depend on the current practices. It is important to note that human health impacts due to transportation are included in the values so care is needed to avoid double counting.

Table 61: Total costs and benefits (internal and external of sludge routes) (in €/t DM)

	Landspreading of semisolids	Landspreading of semisolid digested	Landspreading of solid	Landspreading of composted
Quantifiable external costs (EU15 average)	2	11	7	13

2.2 Environmental impacts from alternative routes of disposal

The environmental impacts from the alternative routes of disposal have been valued before. The category of impacts valued are similar to the direct environmental impacts, but care is needed in order to avoid double counting with the social impacts as they include human health impacts due to emissions.

Table 62: Total costs and benefits (internal and external of sludge routes) (in €/t DM)

	Landfilling[1]	Co-incineration[2]	Mono-incineration[2]
Quantifiable external costs (EU15 average)	10	49	45
[1]Includes human health and climate change [2]Includes energy recovery, human health, climate change, building degradation, impacts from landfilling of ash			

In order to estimate these impacts in monetary terms, estimates will also be needed on the how the disposal routes are affected by the Option. In absence of any information on the different disposal routes, the same ratios on trends for the different disposal routes as reported in the Interim report will be applied. The interim report revealed that some countries (for example, Germany) have diversified outlets, with growing reliance on incineration with energy recovery (sludge powered generators) while some countries are committed to single options (for example, Netherlands relies almost entirely on incineration or Romania on landfilling).

3 Social Impacts

3.1 Human Health Impacts

The human health impacts will stem from the following:

- Reduced application on land: the main route that will affect human health is through the consumption of contaminated foodstuff (animal and vegetal). Other impacts could arise through dermal contact with soil and/or with sludge or compost through manipulations (workers);
- Following sludge disposal to landfill, three main exposure routes may directly and indirectly affect human health. Firstly, human beings may be directly affected by landfill gas inhalation, or indirectly following ingestion of contaminated vegetal or animal products. human health may also be affected by leachate if this is emitted to surface or groundwater; and
- Following sludge disposal to incineration: human health may be directly and indirectly affected by two main exposure routes following sludge incineration. Firstly, human beings may be directly affected by flue gas inhalation, as it contains compounds such as heavy metals, dioxins, HCl, NOx, SO2, or particulate matter, or indirectly following ingestion of vegetal or animal contaminated products by flue gases. Human health may also be affected by waste water produced during the wet treatment of flue gas if this is emitted to surface or groundwater.

The impacts on human health for the different disposal routes are included in the values given in section 1.5.2, thus when the amount of sludge being recycled and disposed of by other means are to be affected by the Options such values will be used to assess the health impacts. It is important to note that the human health costs relate mostly to the costs of transportation and emissions of pollutants to air from incineration, as there is a lack of dose-response data based on concentrations of pollutants in sludge. Thus, they will under estimate the total costs and benefits from the Options.

3.2 Employment Impacts

Although the options may facilitate new job creation through increased monitoring by public authorities these impacts are unlikely to be significant.

Other social impacts, e.g. job quality, social inclusion, gender equality are also unlikely.

4 Distributional Impacts

Two main types of distributional impacts have been considered for this assessment are:

- Distribution of impacts among MSs:
- Distribution of impacts among stakeholders.

4.1 Distribution of impacts among MSs

The distribution of impacts among MS will depend on national legislation and practices. The 2002 report by Andersen and Sede estimated that four MS would face more than 80% of the total costs. These MS were Germany, the UK, France and Spain, based on the amount of sludge produced and recycled.

New information has been gathered for the current project, and projections have been made of future sludge volumes. This includes more information available on the new MS from the first consultation so the ranking will have to include these. Countries such as Poland, Hungary, the Czech Republic and Romania recycle a significant amount of sludge to agriculture so they may bear a higher proportion of costs should the situation change.

The approach to assess the distributional impacts among MS will be based on the percentage of sludge affected by the Options mainly against the total sludge affected across all MS. It is important to note that in cases there will be regional differences within the same MS but these have not been assessed here to ease the analysis. These differences will be considered in the next stage of the report.

4.2 Distribution of impacts among stakeholders

As for the impacts among different stakeholders, the 2002 report concluded that this distribution will change significantly according to the response by the stakeholders. While under the no pollution prevention policy scenario the costs are mostly borne by local authorities, followed by farmers and then citizens, should the companies decide to adopt pollution prevention measures, the costs will shift from the local authorities, farmers and citizens to the industry. Against this, we believe that when the industry has already applied pollution reduction measures, the main costs of the Options are likely to fall on the regulators. Should the companies be affected by new treatment requirements, the costs are likely to fall onto them but be ultimately be supported by consumers. The incidence of this will also have to be considered.