Questionnaire regarding handling of contaminated soil

Report of Answers 2011

(Participants: Amsterdam, Copenhagen, Hamburg, Helsinki, London, Oslo, Stockholm, Vienna).

The investigation was carried out by the Technical and Environmental Administration, City of Copenhagen

CITY OF COPENHAGEN

Questionnaire on contaminated soil – Report of answers

The Technical and Environmental Administration, City of Copenhagen is conducting a project to increase our knowledge regarding handling of contaminated soil. As a part of the project, in January and February 2011, a questionnaire was sent of to a number of Capital Cities in Europe. The questionnaire pertains to the handling, treatment and final disposal, as well as to threshold values for contaminated soil. The following report is based on the responses to the questionnaire. It reports all the answers from the participating cities (in alphabetical order) and it gives a brief summary of the answers to each question. It has been distributed to the participants, which allows for all the participating cities to derive benefit from the project.

A) General information

Name of people filling out the questionnaire

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Question A1: What are the most common sources of soil contamination in your city?

Amsterdam: Diffuse contamination (lead, zinc, PAH), and contamination caused by sources like oil tanks, old gasworks, chemical factories etc.

Copenhagen: Diffuse contamination: Lead and PAHs (especially Benzo(a)pyrene).

Hamburg: Arsenic, heavy metals and PAHs

Helsinki: Soil contamination in Helsinki is mainly due to: Former industry, landfill, made land, shotgun ranges, two former gasworkplants, several petrol stations => Contaminants in soil: Petroleum hydrocarbons, PAHs, PCB, Pb, Zn.

London: Small scale commercial and industrial activities. Not much heavy industry in the City of London (NOTE: this refers to the square mile, not Greater London)

Oslo: Diffuse contamination originating from historical industrial activities, "City Soil" influenced by many years of different city-activities.

Stockholm: Diffuse contamination mainly by lead and PAH, and contaminated soil that has been used for filling on different occasions.

Vienna: Mineral oil – Hydrocarbons (From Gas-stations and accidents), Chlorinated solvents (small-scale dry cleaning activities), PAHs.

SUMMARY OF ANSWERS: In general the type of contamination is comparable from city to city. It originates mainly from different industrial activities being typical in city zones – and from diffuse contamination. Hydrocarbons, PAHs and different heavy metals like lead (and Zinc) seem to be the most common pollutants.

Question A2: Are there any contamination problems that are special for your city (compared to the general picture seen in large cities in Europe)?

Amsterdam: Amsterdam is not quite different from other large cities with a contaminated filling layer in the inner city. Sometimes there are restrictions on use (due to health security, especially due to lead). Our gasworks are almost remediated. Our suburbs are generally not contaminated.

Copenhagen: We have rather large areas which have been affected by gasworks. The remediation has been substantial. We also have areas in the city, where the groundwater is used for drinking water – here the contamination might cause extraordinary problems.

Hamburg: In Hamburg we have about 2300 contaminated sites (either based on soil analyses or on knowledge on potentially polluting activities) with special contamination situations (for example chemical dry cleaner, gasworks, waste disposal sites etc.) Besides that there are areas with widespread high background pollution (industrial environment, wetland/marshes).

Last but not least; every year about 4-6 mio. m^3 more or less contaminated sediments are dredged of the river Elbe and Hamburg Harbour. Nowadays the dredged material will be reused under controlled conditions or deposited in landfills. Until the 1970s both clean and contaminated sediments were used for raising of marsh areas (so called historic sludge depositing sites).

Helsinki: City planning leads to new land use (mainly for dwelling), e.g. on areas of former landfill, industry, oil-harbour, harbour and shotgun-ranges. We always have to consider soil suitability for the new land use.

London: None in the City of London specifically. In Greater London, there is a "push" to develop more brownfield sites, but this may be a help rather than a problem.

Oslo: Acidic types of rocks (for instance aluminious slate) have been defined as contaminated in Norway from July 2009. This type of rock is very common in Oslo.

Stockholm: A number of gasworks has been situated in the center of the city and many industries have originally started their factories in the area which today is the center of the city. The groundwater is not used for drinking water purposes in Stockholm, so there is no need for special care due to that.

Vienna: Below Vienna there are a lot of remainings of old historical buildings. War-damages sometimes give rise to a high level of hydrocarbons in soil.

SUMMARY OF ANSWERS: On top of the standard pollution pattern (being soil pollution originating from e.g. diffuse contamination), some of the cities also have some issues that are more unique. A city like Helsinki (placed close to the sea) mentions polluted habour-areas. The same goes for Hamburg, who dredges 4-6 mio. tonnes of sediments from the river Elbe and the harbour. Oslo has problems with a (naturally occurring) type of acidic rock, which has been defined as pollution on a national level. Both Stockholm and Copenhagen has larger areas that have been affected by gasworks. Copenhagen faces a challenge since the ground water below the city is used for drinking water. Vienna mentions remaining of old buildings and war damages as a special type of pollution. These different situations show that the cities face different challenges when it comes to pollution.

Question A3: How much soil is treated/moved around per year in your city?

Amsterdam: Approximately 3.2 million tonnes of soil is applied in Amsterdam in 2009 (sometimes sand is placed on top of the peat to make sure that the geotechnical strength of the soil is high enough to support houses and so on). 0.13 million tonnes is deposited.

Copenhagen: Approximately 1 mio. tonnes of clean soil and 1 mio. tonnes of polluted soil.

Hamburg: 3.5 mio. tonnes (without hazardous waste) according to the Waste Management Plan (construction and demolition waste) 2006.

Helsinki: One million tons of clean soil and 200 000-350 000 tons of contaminated soil, which are transported to treatment or to deposit areas situated outside Helsinki.

London: -

Oslo: According to informations given by the largest entreprenuers approximately 2 mio. m^3 (ca. 4 million tons) of soil is generated by building activities in Oslo. Approximately 1.2 mio. t. is deposited as contaminated soil.

Stockholm: There is no reliable statistics on the matter. There are many actors and no obligation to report.

Vienna: 3.152.000 t in 2010.

SUMMARY OF ANSWERS: All of the participating cities are moving rather large amounts of soil every year (keeping in mind, that a standard truck holds approximately 30 t of soil): In Oslo approximately 4 mio. tons of soil is moved around every year. In Hamburg the number is 3.5 mio tonnes (and in addition to this 4-6 mio. tonnes of sediment). In Vienna the number is 3.152.000 t in 2010, Copenhagen moves approximately 2 mio. t of soil every year (half of it being clean soil) and in Helsinki the figure is approximately 1.3 mio. t of soil (1 mio. t. being clean soil). In Stockholm and London there are no statistics on the matter.

Question A4: In Copenhagen the most common soil type is sandy clay containing calcium-carbonate. What is the most common soil type in your city?

Amterdam: Peat and sandy clay in the subsoil, with a sandy filling layer on top (appr. 2.0 meters). The original soil in Amsterdam is not suitable for building, it's too weak.

Copenhagen: Sandy clay containing calcium-carbonate.

Helsinki: Till, clay

Hamburg: In the northern part of Hamburg: Loamy sand/sand. In the southern part of Hamburg (marsh of the river Elbe): loam/sandy loam/clay/peat

London: Silty clay/mudstone, sandy silts and sandy clayey silts of marine origin.

Oslo: In the lower-situated parts of Oslo marine material deposited after the last ice age is most common, giving clay rich or silty soils. In areas situated above the marine border (approximately 220 meters above sea level) moriane-materiale is most common, giving areas dominated by sand, gravel and stone. Oslo also partly consist of rocks that are bare or covered by a thin layer of soil.

Stockholm: The original soil is moraine consisting of clay, but often the top soil consists of soil fillings that also contain tiles and other construction and demolition waste.

Vienna: Chernozem (a black-coloured soil containing 7 to 15% humus, and high percentages of phosphoric acids, phosphorus and ammonia) covering a sandy subsoil respectively brash.

SUMMARY OF ANSWERS: The soil type differs quite a lot from city to city, although most of the cities report areas of more or less clayey soil. In Amsterdam they also have areas with peat (covered by sandy fillings on top), in Vienna they have Chernozem (a black-coloured soil containing 7 to 15% humus, and high percentages of phosphoric acids, phosphorus and ammonia) as a topsoil. In Hamburg there is a significant variation between the northern and the southern part of the city. That the soil types differs this much between cities might have an influence on issues like the extend and type of soil remediation (since for instance the clay content of the soil is important to the magnitude of the diffusion of pollution in soil. It also influences the effect of remediation methods like soil wash).

B) Questions regarding depositing of soil

Question B1: In Denmark the legal system describes threshold values for some pollutants on a national level, whereas other pollutants are regulated by the municipalities. Does your city have additional threshold values for depositing of soil, or threshold values that differ from the national threshold values?

Amsterdam: In the Netherlands soil deposits has to have an environmental authorization of the Environmental Protection Law. Permanent depositing of soil is only allowed if the soil cannot be cleaned. The municipality of Amsterdam has a few soil deposits, they categorize the soils in different types (after examination. The individual soil deposits have different threshold values.

Copenhagen: Yes

Hamburg: No

Helsinki: Helsinki has no own contamination values but implements the national threshold and guideline (upper and lower) values (see appendix 1-table A7). There are 3 categories of concentration values (+hazardous) to divide the material for reuse, deposit (on e.g. landfills), and (heavy) treatment. In Helsinki we do not have any soil deposit pits. In Finland it is common to implement the lower guideline values for soil being deposited. It is very common to reuse contaminated soil in landfill areas for daily cover of household waste, for such purposes soil contamination limit is the upper guideline value (see appendix 1-table A7). In principle, it is not allowed to deposit contaminated soil if TOC is over 5% to the household waste landfills. Main principle: Up to threshold value = free to use. Up to lower guideline value = sometimes valid for made land use on yards or otherwise taken to soil deposits. Up to upper guideline value = cover-layer (reuse) on household landfills.

London: No - all threshold values for deciding whether soil is contaminated (SGVs – Soil Guideline values) are national (See appendix 1-table A8). The SGVs are guideline values and Professionals and regulators assessing risks to health from land contamination are not required to use SGV. The local authority decides what is "contaminated land" based on their own judgment of whether land presents a "significant possibility of significant harm". So while the values are national, there is some local judgment required. The existence of a pollutant linkage alone does not make land contaminated land. The effect of the substances must be that significant harm is caused or there is significant possibility of such harm being caused; or there is pollution of controlled waters.

Oslo: No, Oslo uses the national threshold values. The threshold values are divided into 5 (human tox-based) classes which is also taking the area-use into account (See appendix 1-Table A9).

Stockholm: No. There are national guidelines for contaminated soil given by the Swedish Environmental Protection Agency (Naturvårdsverket) but they apply to the soil that can be left at site without samples and measurements.

Vienna: Whereas other "Bundesländer" have laws for the protection of soil, Vienna does not have its own law on protection of soil.

SUMMARY OF ANSWERS: Only Copenhagen has local threshold values for a number of pollutants. The other participating cities use national guidelines/threshold values. While most of the cities have threshold values to determine whether a soil is contaminated or not, only Copenhagen and Vienna (using national values) mentions specific threshold values for soil that is being deposited.

Question B2: In Copenhagen we usually do not deposit clean soil - and are not allowed to deposit soil that is considered hazardous waste. Are there upper and lower threshold values for the soil you are depositing in your city?

Amsterdam: Soil deposits have their own rules of acceptance for different values of contamination depending on their authorization.

Copenhagen: Yes – although some soil deposits (not in Copenhagen), has a permission to deposit clean soil. Only one site in Denmark (Kommune Kemi) has a permission to deposit soil that is considered hazardous waste. Some of the soil that is categorized as hazardous waste is exported to (mainly) Norway or Germany.

Hamburg: Soils with pollution above a determined threshold value have to be deposited (the Z2 value in table A6). Contaminated soil with lower pollution levels is recovered if possible. Hazardous waste can also be deposited.

Helsinki: We try to reuse all clean soil but e.g. clay is not much needed; this is taken to the deposit pits. Hazardous waste is not deposited in Helsinki. In general the soil between the threshold value and the lower guideline value is taken to soil deposits (appendix 1-table A7).

London: Probably not. Defining whether or not soil is classed as a "waste" is quite complicated, and can require lawyers and/or consultants.

Oslo: The Norwegian set of rules does not hold any lower threshold value regarding depositing of soil. You can deposit clean soil, if you wish to do so. If the soil is contaminated above the threshold values for hazardous waste it can not be deposited. These are the masses that exceed Class 5 (See appendix 1-table A9). Hazardous waste must be taken to special deposits that are approved for treatment of these soils.

Stockholm: We do not have any soil deposits in use in Stockholm, but most of the soil that is removed is taken to deposits outside the city. Every soil deposit has a permission containing the conditions describing which type of polluted soil they are allowed to receive.

Vienna: There are different threshold values for different “Deposit-classes” (appendix 1 – table A14). Clean soil is reused (specific rules regarding soil quality and suitability for construction purposes should be kept). In principle it can also be deposited (does not happen very often, since a waste-tax has to be paid). If a specific project includes the use of excavated soil, which meets the demands regarding quality and suitability for construction, the use is legal. Juridical it is no longer waste and therefore a waste tax should not be paid.

Hazardous waste is not deposited in Austria, since there is no deposit that can receive hazardous waste. Hazardous excavated soil can be treated (either biological or by use of soil wash) and can be deposited after the treatment, if it can be proved that it is no longer hazardous waste. Otherwise it is taken to a deposit for hazardous waste (in Germany). The amount of hazardous waste going to Germany from Austria is however limited.

SUMMARY OF ANSWERS: In Amsterdam and Stockholm, what can be deposited depends on the authorization of the soil deposit. In Helsinki, Oslo and Vienna there are no lower threshold value; in principle clean soil can also be deposited. In Helsinki this happens because there is no need for the clean soil (e.g. clay). In Vienna on the other hand it happens very seldom since a waste tax has to be paid when soil is deposited. Regarding the upper threshold value, both Denmark, Finland, Sweden and Norway has special deposits that handle these very polluted soil (that is considered hazardous waste). In Austria they do not have deposits that handle hazardous waste. It is remediated if possible, or it is shipped of to soil deposits in Germany (does however only happens seldom).

Question B3: For which pollutants do you have threshold values for depositing of soil in your city? And what are the values?

Amsterdam: According to the answers in B1 and B2 the threshold values varies from deposit to deposit.

Copenhagen: The lower threshold value (appendix 1 – table A2) is a threshold value for clean soil given on a national level. The hazardous waste limits are also national but they are only guideline values. The upper threshold values refer to limit values for the soil deposit placed in Copenhagen. The soil deposit is owned by the municipality.

Hamburg: Depositing of soil is regulated by a national ordinance on landfill of waste. It contains several deposit classes (DK 0 up to DK IV) with increasing requirements regarding sealing, drainage etc. DK III and DK IV are deposit-classes for hazardous waste (Appendix 1 – table A5). Besides threshold values of national ordinance, some soil deposits have further individual threshold values for specific parameters.

Helsinki: Lower and upper guideline value for depositing of soil is given in the scheme in appendix 1-table A5. In general soil having contents of pollutants between the threshold value and the lower guideline value is often taken to soil deposits (or sometimes it is valid for made land use on yards). Soils having contents from the lower to the upper guideline value is used for cover-layers on household landfills.

London: -

Oslo: There are no lower threshold value, but hazardous waste must not be deposited, which means that soils having contents of pollution exceeding the upper-value in class 5 (see appendix 1), must not be deposited.

Stockholm: -

Vienna: See appendix 1 – table A14. The threshold values are national.

SUMMARY OF ANSWERS: In Amsterdam soil deposits have their own rules of acceptance for different values of contamination depending on their authorization. In Hamburg there is a system, which holds 4 deposit classes. Besides that, some soil deposits have additional threshold values. In Stockholm there are no soil deposits. In London all threshold values are given on a national scale. In Oslo there are no lower values defining when soil must be deposited, the upper limit is set by a hazardous-waste-value. In Finland it is mainly the medium polluted soil that is being deposited: The clean soil can be used as you like. The more polluted soil is often used as cover-layers on household landfills. In Copenhagen the clean soil and the soil that is considered hazardous waste is not deposited. Besides that the threshold values in Copenhagen are local.

Question B4: If you are not allowed to deposit soil that is considered hazardous waste, what is then the fate of the soil that is classified as hazardous waste?

Amsterdam: Permanent deposit is only allowed when soil is not cleanable. If it's not cleanable, a certificate of 'not-cleanability' is necessary. Threshold values are no issue here.

Copenhagen: It depends on whether the contamination is organic or inorganic. If it is organic, it should be cleaned. If it is inorganic there is one soil deposit that is allowed to receive hazardous waste (not in Copenhagen). In some cases the soil that is considered hazardous waste is exported.

Hamburg: Depending on the kind and concentration of substances it can be allowed to deposit hazardous waste or to reuse it (usually after treatment). As mentioned in the answer to question B3, there are two deposit classes which pertain to hazardous waste.

Helsinki: Soil with organic contaminants is taken to incineration or it is taken to a isolated hazardous waste landfill (in Southern Finland, not in Helsinki). Soil with inorganic contaminants is subjected to stabilization (or/and) isolated hazardous waste landfill

London: I think you are allowed to send this soil to landfill - but only special hazardous waste landfills

Oslo: Hazardous waste is taken to approved treatment plants. Here it is subjected to a controlled burning-process.

Stockholm: Soil that contains so high values of pollution that it is defined as hazardous waste is taken to deposits which have a permission that allows them to receive the soil.

Vienna: Soil originating from a brownfield/abandoned hazardous site is considered apriori as hazardous waste. An appropriate "declassification-application" containing documentation and analysis of the material must be handed to the Ministry of the Environment. The Ministery approves the documents; if 6 weeks passes without objections, the material is now considered non-hazardous. Now it can be taken to a deposit for non-hazardous-waste. Real hazardous excavated soil can be subjected to a treatment (For instance soil wash). If the remediation is successful it can be deposited in a soil deposit. Otherwise it is taken to a deposit for hazardous waste (in Germany). The amount of hazardous waste going to Germany from Austria is however limited.

SUMMARY OF ANSWERS: Both Denmark, Sweden, Finland and Norway has special deposits that handle these very polluted soil (that is considered hazardous waste). In Austria they do not have deposits that handle hazardous waste. It is remediated if possible, or it is shipped off to soil deposits in Germany (does however only happens seldom). In Hamburg hazardous waste can be deposited if it cannot be remediated.

Question B5: In Denmark only public institutions are allowed to run soil deposits. Are private companies allowed to run soil deposits in your city?

Amsterdam: Yes, but they must have an authorization according to the Environmental Protection Law.

Copenhagen: No, except for deposits for clean soil.

Hamburg: Yes, a lot of soil deposits are runned by private companies.

Helsinki: In Finland yes, but as mentioned there are no soil deposits in Helsinki. We like to reuse the (slightly contaminated) soil by building noise barriers or such.

London: Yes

Oslo: Yes, private companies are allowed to run soil deposits. It takes a permission from the authorities on a county level, along with a local approval from the municipality. The permission is given on the condition that no contamination of the surroundings takes place.

Stockholm: Everyone who has a permission (issued by the County Administration) can be soil deposit owners. There are no local rules.

Vienna: Yes, but the employers must have a special education. In Austria the supervisory body functions as an extended arm of the Authorities. The supervisory body (for instance a civil Engineer), who is appointed by the authorities and paid by the manager of the deposit, controls the deposit regularly and at least following a predefined schedule (but they also come unannounced). The supervisory body must send a report regarding his/hers supervision to the authorities every year and if there are any anormalities during the year he/her must also inform the authorities. The authorities make further control and larger revisions must be conducted on a regular basis (at least every 5 years).

SUMMARY OF ANSWERS: In all cities except Copenhagen, private companies are also allowed to run soil deposits. However most of the countries mention that when private companies are allowed to administrate soil deposits it takes a permission given by different public institutions. Vienna describes a system where a supervisory body is also keeping an eye on the deposit.

Question B6: What are the prices for depositing of soils in your city (per tonnes)?

Amsterdam:
Clean soil (sand, peat): free
Clean soil (clay): € 7/t.
Little contaminated (not exceeding the threshold values given for "industrial use" in appendix 1 – table A1): € 5/t
Contaminated (exceeding the threshold values given for "industrial use" in appendix 1 – table A1): € 11/t

Copenhagen: 9 €/t (for heavily polluted soil the price is 17 €/t, however only 5000 t of heavily polluted soil is deposited every year).

Hamburg: The prices have to be requested in each individual case.

Helsinki:
10-25 euros/ton
Prices depend on the need of material for daily cover in landfill areas.

London: There are two prices, as contaminated soil used to be exempt from landfill tax. Without landfill tax, the median cost is 25 €/t. With tax, the median cost is 79 €/t. The exemption is being phased out, so some older sites don't pay landfill tax, most newer sites do. After April 2012, landfill tax has to be paid for all contaminated soils going to landfill (Costs are taken from:
http://www.wrap.org.uk/recycling_industry/publications/gate_fees_2010.html

Oslo: The price depends on the level of contamination and how much soil is on the marked (if there is more soil available, the price for depositing is rising).
Clean soil: 6,35 – 12,7 €/t. Moderately contaminated soil: 25,4 – 31,75 €/t. Highly contaminated soil: 55-80 €/t

Stockholm: -

Vienna: Clean soil: 2 €/t. Material quality that can be deposited in a demolition-waste landfill: 18 €/t. Material of quality suitable for residual-waste landfill or mass-waste landfill can cost up to 100 €/t.

SUMMARY OF ANSWERS: In general the price for depositing of soil depends on the pollution level of the soil:
In Amsterdam the depositing of clean sand or peat is free (clean clay 7 €/m^3). Slightly contaminated soil cost 5 €/t. Contaminated soil cost 11 €/t.
In Hamburg it depends on the specific case.
In Helsinki the price is between 10-25 € /t. Here the price is very dependent on the need for material for daily cover of landfill areas (which the polluted soil is often used for).
In Oslo the price for depositing of clean soil is 6,35 €/t – 12,7 €/t. Moderately contaminated soil costs: 25,4 €/t – 31,75 €/t. Highly contaminated soil: 55 €/t - 80 €/t.
In Vienna the prices ranges from 2 €/t (clean soil) to 100 €/t (soil suited for a mass waste-landfill).
In London the median cost is 25 €/t without landfill tax. Including the tax the median price is 79 €/t. After April 2012, landfill tax will have to be paid for all contaminated soil going to landfills.
In Copenhagen the price is 9 €/t for moderately polluted soil (for heavily polluted soil the price is 17 €/t, however only 5000 t of heavily polluted soil is deposited every year).

C) Questions regarding Reuse of Soil

C1) In Denmark the legal system describes threshold values for some pollutants on a national level, whereas other pollutants are regulated by the municipalities. Are there national threshold values for contaminated soil being reused in your country?

Amsterdam: In the Netherlands the legal system describes threshold values for certain pollutants (standard package of most common pollutants). Municipalities are authorized to develop their own threshold values, focused on their local situation (with studies of human and ecological risks included).
Threshold values are dependant on the use function of the area, limited to the criteria of remediation. The use function 'children playground' has lower threshold values compared to 'infrastructure' or 'industrial area'. The chosen threshold values are based upon the risks of exposure.
In Amsterdam we are busy to develop our own threshold values for the diffuse contaminated inner city. The national standard threshold values suffice for the suburbs (with clean soils).

Copenhagen: Yes. But since the law does not apply for soils containing organic contamination above the detection limit, the law is practically never used. A new edition of the law is on its way, this new edition will also embrace the soils that contaminated by organic contaminants. Today, instead an individual judgment and permit based on §19 in the Danish law on Environmental Protection is used.

Hamburg: In Germany we don't have any national law or ordinance regulating the reuse of soil. However there are guidelines regarding the issue (so called LAGA M 20), which is acquired by the federal states of Germany. The guidelines contain several threshold values from" Z0" to "Z2". Within this guideline, contaminated soil can be reused without any concession; otherwise it needs a special permission. Soil that is contaminated above Z2 is mostly deposited.

Following the EU regulations the basis for waste management in Germany is the "waste hierarchy":1. Prevention 2. preparing for reuse 3. recycling 4. other types of recovery, 5. disposal. Only waste without any possibility to recover is deposited

Helsinki: Yes. Threshold values + risk assessment. Soil containing contamination below the threshold values is not classified as contaminated soil, and there is no restriction on the use because of pollutants.

London: The decision of what soil can be reused, and what is waste is quite complicated, and can require lawyers and/or consultants.

Oslo: Yes.

Stockholm: The Swedish Environmental Protection Agency has given recommendations on levels of pollution in soil that can be reused without restrictions (see appendix 1 – table A11). For reuse of soil with higher pollution-levels it takes an application or a permission (Depending on the content of pollution).

Vienna: The Federal Waste Management Plan is published by the Ministry of the Environment every 5 years. It describes the rules for reuse of excavated soil. There are different land-use-classes for agricultural use, for subgrade Backfilling and for subgrade back filling in areas where groundwater is used for drinking water. The threshold values can be seen in appendix 1 –tables A12 and A13.

Excavated soil that is contaminated must not be reused in Austria.

SUMMARY OF ANSWERS: Amsterdam, Hamburg, Helsinki, Oslo, Stockholm, Vienna and Copenhagen have national threshold/guideline values when it comes to reuse of polluted soil, whereas there are none in London. In Vienna the reuse of soil is described in The Federal Waste Management Plan, which also holds rules regarding the technical standards of the soil that is being reused. In Stockholm the Environmental Protection Agency has given recommendations for soil that can be reused without restrictions. For reuse of more polluted soil a permit is needed. In Copenhagen there are national threshold values; however since the law does not apply for soils containing organic contamination above the detection limit, the law is practically never used. In the Nederlands the national legal system describes threshold values for some pollutants on a national level. The municipalities are however also authorized to develop their own threshold values based on the local situation.

Question C2: For which contaminants do you have national threshold values for soil being reused? And what are the values?

Amsterdam: See appendix 1-table A1.

Copenhagen: See appendix 1 – table A3

Hamburg: See appendix 1-table A6.

Helsinki: Soil that is below the "threshold value" in the scheme shown in appendix 1-table A7 can be reused without restrictions. If concentrations of pollutants are below the "lower guideline values", excavated soil can usually be reused on yards, otherwise a permit from the Environmental Authorities is needed (the environmental authorities determine the acceptability of the reuse and provides regulations).

London: There are certain parts of the UK where certain contaminants are naturally very high, so the levels in these areas would be different to other areas. And if a soil comes off a site where levels of some pollutants are naturally high, it cannot be re-used in an area where levels of those pollutants are naturally low.

Oslo: The threshold values are given in appendix 1-table A9. Reuse of soil in Norway is controlled by the soil-classes, area-use and property issues.

Stockholm: Soils having a content of contaminants below specific values can be reused without restrictions (see appendix 1 – table A11).

Vienna: The threshold values for reuse of soil are national. The values are shown in table A12 and A13.

SUMMARY OF ANSWERS: Most of the countries have threshold values for soils that can be reused almost without restrictions. While the threshold values do not differ a lot from country to country (in most cases!), there are big differences between the number of pollutants that the countries have given threshold values for. Apart from threshold values for soils that can be reused without restriction, most of the countries have more soil categories for reuse of soil. The different categories can either be based on the land-use in the areas where the soil is to be reused, or perhaps the categories might control the size of the project or the type of analyzes that has to be done. The categories can also be dictating claims regarding a top cover.

Question C3: Are there any local threshold values applying specially for the soil being reused in your city? If yes, what are they?

Amsterdam: We are busy to develop local threshold values.

Copenhagen: No

Hamburg: No

Helsinki: No, but in addition to using the national threshold values (in table A7 in appendix 1), there is also a local risk assessment taking place.

London: No, none specific to London. Please see response to C1.

Oslo: No, there are only national threshold values (See appendix 1-table A9). Soil in Oslo often has higher contents of Arsenic compared to the rest of the country. In the regulations it is described that soil that has a little higher concentration of Arsenic can be considered clean soil, and can be reused on other areas, if it can be documented that the area receiving the soil also has higher values of arsenic. There are however not given any level for these cases.

Stockholm: For reuse of soil Stockholm allows soil concentrations in accordance with the levels given by the Swedish Environmental Protection Agency for "less sensitive area-use" (MKM-values: see appendix 1-table A10). The reuse has to be reported to the municipality.

Vienna: No

SUMMARY OF ANSWERS: Amsterdam, Hamburg, London, Oslo, Vienna and Copenhagen have no local threshold values applying especially for the soil being reused in their cities (they use only national threshold values). Stockholm allows soil concentrations in accordance with the levels given by the Swedish Environmental Protection Agency for "less sensitive area-use". Helsinki uses the national guidelines, if the local risk assessment says so.

C4: When reusing soil, are there any requirements to the size of the project? If yes, please specify the requirements

Amsterdam: In big projects (more than 5000 m^3 and higher than 2 m) there are special requirements - such as leaching tests.

Copenhagen: Yes, if the soil is placed in category 2 and 3 (see appendix 1 – table A3), there are. The requirements are mainly relating to the allowable thickness of the projects.

Hamburg: No

Helsinki: No. But the size of the project is the matter that choose the proper authority to grand the permit (municipal or state).

London: Not as far as I know. However all construction sites are encouraged to protect their soil, and re-use it where possible (read more on http://www.defra.gov.uk/publications/files/pb13298-code-of-practice-090910.pdf)

Oslo: No

Stockholm: No

Vienna: Yes. If the projects are below a certain size, an exception to the obligation to analyse exists. In practice this exception goes for: Building projects up to 2000 t excavation volume or up to 2000 t material to be backfilled and for up to 7.500 t excavation volume to be backfilled at the same property (however only if the soil is clean which means that the former utilization at the site does not give any suspicion and that no abnormality in colour or odour is found during the excavation process).These limits only stand for the obligation to analyse. Projects can be carried out at every size you wish, however then you need a corresponding documentation (chemical and structural engineering material quality). Additionally you might need permission according to other laws (building law, nature protection law, law on water rights).

SUMMARY OF ANSWERS: Only Copenhagen has restrictions on the size of the project: If the soil is contaminated above a certain level (class 2 or 3), then there are limits to the allowable size. Amsterdam, Hamburg, London, Oslo, Stockholm and Helsinki have no requirement to the size of the project. However in Helsinki the size of the project is the matter that appoints the proper authority to grand the permit (municipality or state). And in Amsterdam and Vienna the size of the project plays a part, when deciding the amount and type of analyses.

C5: When reusing soil, are there any requirements to the geographical placement of the project? If yes please specify the requirements

Amsterdam: You have to pay attention to the sub-soil, the quality may not decline. The soil-quality is shown on a Soil Quality Map. The territory of Amsterdam is divided into different areas with their own soil quality (clean, lightly contaminated, more contaminated, etc).

Copenhagen: If the soil is placed in category 2 and 3, there are requirements to the distance to places with extraction of drinking water (30 m). And in general the projects need to covered by a sealed surface if they are Category 2 or 3.

Hamburg: No

Helsinki: Concentration of harmful substances in soil being reused may not be over threshold values in ground water areas (Table A7 – appendix 1). And the contamination in the reused soil must not exceed the contamination in the soil in the destination area.

London: Sometimes - As mentioned in QC2, if a soil comes off a site where levels of some pollutants are naturally high, it cannot be re-used in an area where levels of those pollutants are naturally low.

Oslo: Yes, when it comes to soil contaminated in Soil-Class 2 or above (appendix 1- table A9) it can be reused on the property on which is has been dug up if the soil class and the area-use is compatible, and it does not induce any risk of diffusion of the contamination. To reuse soil that is exceeding Soil Class 1 on another property you would need a dispensation given by the authorities. Clean soil (Soil Class 1) can (theoretically) be used as you like.

Stockholm: If the reuse takes place close to sensitive recipients that are used for drinking water, or in a nature reserves or where there is a sensitive area-use like for instance in kindergartens, only soil contents equal to or lower than the values given for sensitive area use (KM-value: Appendix 1- table A10) can be accepted.

Vienna: The Federal Waste Management Plan describes the rules regarding the technical standards when it comes to reuse of excavated soil. There are different classes depending on the land-use (for agricultural use; for subgrade backfilling; for subgrade back filling in areas where groundwater is used for drinking water). So limitations are mainly due to the characteristics of the area. See also appendix 1 – table A12 and A13.

SUMMARY OF ANSWERS: Helsinki, Stockholm, Vienna and Copenhagen have restrictions when it comes to placing the reused soil close to drinking-water resources. Stockholm mentions that higher soil contents also results in restrictions on the use of the soil in sensitive areas like for instance kindergartens.
In Amsterdam attention has to be paid to the subsoil, as the quality may not decline. This is also taken into consideration when reusing soil in London. In Oslo only Clean soil can be used without restrictions. Otherwise in Oslo the pollution level needs to be compatible with the area use (e.g. pollution level 3 or above; not allowed for dwelling; kindergartens; parks; other sensitive area use).

Question C6: When reusing soil, are there any requirements regarding documentation of leaching from the soil? If yes, what are the requirements?

Amsterdam: Only in big sized projects leaching has to be considered, because in these projects it's not necessary to check the quality of the subsoil.

Copenhagen: These are mentioned in table A3 – appendix 1.

Hamburg: See appendix 1 – table A6.

Helsinki: In most cases: No. There are some leaching tests to be carried out to get to know soil´s (wastes´) acceptability to landfill when the concentration exceeds the lower guideline value.

London: I'm not aware of any legislation on this, but there is a Guidance, which states that the concentration (including what might leach from the soil) must be lower than the concentration where the soil is to be re-used.

Oslo: Yes, by reuse of the masses classified as soil-class 4 and 5 (in less sensitive areas) it is demanded that a risk-evaluation is performed. The risk evaluation should document that the diffusion of the contamination is low.

Stockholm: A leaching test is demanded in connection with reuse of soil the make sure that the soil is Inert

Vienna: Yes. Please see the limit-values for leachate in appendix 1 – table A13.

SUMMARY OF ANSWERS: In Stockholm, Vienna, Copenhagen there is demands for leaching tests. In Oslo the leaching tests are demanded when the more polluted soil classes are being reused (soil class 4 and 5). In Amsterdam it is the size of the project that matters when it is decided whether leaching tests are necessary (more than 5000 m^3 and higher than 2 m).

D) Questions regarding Remediation of Soil

D1) In Denmark we do not have a national strategy describing when soil should be cleaned. However in Copenhagen we have a set of regulations describing the remediation of soil. Do you have national regulations in your country, describing when soil should be remediated? If yes, please describe them

Amsterdam: Yes, we have a national strategy. First we look to see if it's a severe case of polluted soil (Defined as more than 25 m^3 of soil above the upper threshold value). The threshold values are given in appendix 1-table A1). If there's no severe case you don't have to take any remediation-action.

Second we make difference between historical (<1987) and new (>1987) cases of pollution. New cases should be removed as quick and complete as possible.

Third you have to remediate if a risk is involved. We have three kinds of risks: for humans, for the ecosystem and for spreading of pollution into the groundwater. If a risk level is exceeded then you have to take action (in most cases within 4 years).

Copenhagen: No, we do not have national regulations of soil remediation.

Hamburg: The Federal Soil Protection Act and the Soil Protection and Contaminated Sites Ordinance contain values for risk assessment. However there are no regulations or values for the remediation of soil. Every plant for soil treatment as well as the remediation of contaminated sites are subjects of case-by-case conditions.

Helsinki: There is no regulation, describing when the soil should be remediated. However if the soil contamination causes harm or risks for health or environment (if the threshold values in appendix 1 – table A5are exceeded) a risk assessment is carried out. This might lead to the conclusion, that the soil should be remediated.

London: As with QB1, the local authority decides what is "contaminated land" based on their own judgment of whether land presents a "significant possibility of significant harm".
The way in which that site is remediated depends on a range of factors, including cost. So whether soil is remediated or not is also an economic decision.

Oslo: Governmental report no. 14 from 2006-2007 “Working together for a environment free of toxic substances” holds guidelines for the public effort against contaminated land. Amongst other things it gives a plan of action for remediation of contaminated soil in Kindergartens. The plan was carried out in the years 2006 to 2010 and was directed towards all kindergartens in the 10 largest cities and the 4 biggest industrial areas in Norway. It also lists some demands for all the contaminated areas that 1) Induces a health risk. 2) Has a risk of diffusion of the contamination. 3) Is situated on Svalbard.

Stockholm: Remediation is suggested but it is not a demand. To use most of the remediation methods you must have a permission except from in-situ remediation (as long as the soil has not been dug up and is remediated at site, it does not take a permission although the action must be reported to the Municipality).

Vienna: In Austria there are substantial rules regarding how and when deposits/landfills should be remediated. Old deposits and old cityzone-areas are reported by the governor to the ministry (Umweltbundesamt). The remediation must follow detailed investigations and priority-evaluations. If the guidelines are met and the financing is in place, the demanded remediation or protection can take place.

When it comes to areas that have been contaminated after 1989, there are no national demands and orders are given according to the different laws (mainly the water-law) by the regional authorithies (for instance if there seems to be a threat towards the groundwater). An Austrian Standard describes control-values and threshold values for actions to be taken when it comes to contaminating compounds in soil. These are used when demands are issued.

SUMMARY OF ANSWERS: Helsinki, Hamburg, London, Stockholm and Copenhagen have no national strategy/regulation on when a soil should be cleaned. In Amsterdam there is a national strategy. The following three elements decide whether remediation should take place: The amount of soil being polluted above a threshold value; whether it is a historical or a new contamination; and whether it poses a risk. In Oslo there are national guidelines for the public effort against polluted land. For instance there is a plan of action against polluted soils in kindergartens. In Austria there are substantial rules on how and when landfills should be remediated.

D2: Do you have local regulations in your city, describing when soil should be remediated? If yes, please describe them

Amsterdam: Yes, for human risks due to lead (Pb) contamination in soil we are busy to develop a less strict risk level.

Copenhagen: Yes we do. If the soil is polluted above the values mentioned in appendix 1- table A4 , then it should be remediated so that the content of contamination gets below the values mentioned

Hamburg: No

Helsinki: Yes, remediation needs are assessed (locally) on the basis of risks assessment. Risk assessment must be carried out when the concentration exceeds the threshold value. The risk assessments are carried out both based on computer-models and common sense. In general Land use exchange, construction activities, selling/renting of real estate emerges remediation actions.

Remark: We have investigated potential (due to the operation history) contaminated sites, and none very urgent to remediate was found. Remediation (more or less) always takes place when: a) land use changes, b) the ownership of real estate changes or c) (oil)spill accident happens.

London: No.

Oslo: No.

Stockholm: No. It is the owner of the waste who decides the treatment. Most soil deposits however have a permission to do treatment.

Vienna: No

SUMMARY OF ANSWERS: London, Hamburg, Oslo, Stockholm and Vienna do not have local regulations describing when soil should be remediated. In Stockholm it is the owner of the waste, who decides the treatment. In London it is the local authorities who decide, what is contaminated land, based on their own judgment and "the significant possibility of significant harm". In Copenhagen, Amsterdam and Helsinki they have local regulations. In Amsterdam e.g. they are developing less strict risk levels for Pb. In Copenhagen they have threshold values for a number of organic compounds. If the soil content are above this level, the soil must be subjected to a (mainly) biological treatment. In Helsinki they initiate remediation based on a local risk assessment. They have recently investigated potential polluted sites, and none very urgent to remediate was found.

D3: Which remediation methods are commonly used in your city?

Amsterdam: Mainly soil moving and transporting the soil to a depositing site. Also by 'top covering' of the remediation site (isolation). Sometimes a combination of earth moving and in situ remediation (of especially hydrocarbons) is used.

Copenhagen: The biological remediation is by far the most common method when it comes to organic contamination. The soil is placed in windrows (mainly ex situ). It is turned (aireated) and watered to secure optimal conditions for the indigenous micro-organisms. For inorganic contamination, dig and dump are the most common method.

Hamburg: This is very dependent on the type of pollution (can be both biological and chemical methods).

Helsinki: Dig and dump to the landfills or to other treatment plant. The majority of contaminated soil being excavated is then reused on landfills or otherwise with or without treatment.
Inorganic harmful substances are commonly isolated with at least 0,5 m thick clean soil layer (or other material).

London: In the City, any contaminated soil would be removed from site (dig and dump), as we are a very built up, urban area. In greater London this would not be the case, and there has been quite a lot of soil remediation in East London, which has recently been regenerated in anticipation of the 2012 olympics.

Oslo: Remediation of contaminated land in Oslo is most often dig and dump (at a facility approved to treatment of contaminated soil). In-situ degradation of oil-contaminated soil has been used on several occasions.

Stockholm: In-situ remediation of hydrocarbon-contamination has been done, but it is less effective due to a high content of clay in the soil. We have had a mobile treatment plant for thermic remediation of Creosote-polluted soil. However it takes a permission which is both time consuming and expensive. To perform the remediation at site is seldom done since it takes up space, while it takes place. To take the soil to soil deposits is preferred by the building and construction companies.

Vienna: Excavation or protection by building a "cage" including filters for the groundwater in combination with removal of soil from Hot-spots, and on rare occasions Natural Attenuation Methods.

SUMMARY OF ANSWERS: Most cities mention that Dig and Dump (removing the soil and taking it to soil deposits) is the most common type of remediation. Both Amsterdam, Helsinki and Vienna uses isolation of the polluted soil by a top cover (e.i. by clean soil) as a common remediation method. The last method mentioned is remediation of hydrocarbon-contamination: This can either be done in-situ (Stockholm, Amsterdam, Oslo) or ex situ (Copenhagen).

D4: What are the estimated prizes of the remediation-methods (per tonnes)?

Amsterdam: For earth moving we use an estimated figure: € 80/t (transport and cleaning included)

Copenhagen: Between 25 € and 100 € for organic contamination, depending on the concentration of the contaminants and especially on the type of contaminants (the price is exclusive transport). The soil contaminated by the "heavy" hydrocarbons and PAHs are the most expensive to remediate

Hamburg: -

Helsinki: 16-1000 euros/ton. It is cheapest just to take the contaminated soil to the landfill, whereas it is most expensive to deposit or treat hazardous waste with PAHs, hydrocarbons.

London: -

Oslo: Removal of soil followed by depositing can be carried out for 50 €/t .
Extraction of volatile organic contaminants (like gasoline) can be carried out in-situ for the price of approximately 125-190 € /t.

Stockholm: -

Vienna: -

SUMMARY OF ANSWERS: In Amsterdam an estimated figure is € 80/t for earth moving (transport and cleaning included). In Oslo removal of soil followed by depositing can be carried out for 50 €/t, whereas extraction of volatile organic contaminants carried out in-situ costs 125-190 €/t. In Copenhagen the (biological) remediation costs between Between 25 €/t and 100 €/t depending on the concentration of the contaminants and especially on the type of contaminants. In Helsinki the price differs a lot; it is cheapest to take the contaminated soil to deposits (16 € /t), and most expensive to treat hazardous waste with PAHs and hydrocarbons (1000 €/t)

E) Questions regarding contaminated sediments

Question E1: Are contaminated fresh-water sediments drained in your city?

Amsterdam: Yes, this is happening all the time due to nautical and hydraulic reasons.

Copenhagen: Today not much is done, due to a lack of possibilities to get rid of sediments (both drained and not drained) within a reasonable price. Especially the high content of TOC makes it impossible to get rid of.

Hamburg: Hamburger Harbour is the largest port in Germany and one of the ten largest ports in the world. In order to maintain the depths of water required for shipping, dredging must be carried out regularly to remove the constant deposition of natural sediments from the River Elbe. Approximately 3 to 4 million m³ of sediment from the Elbe has to be dredged each year.

Helsinki: In Helsinki there is only very few fresh-water basin/streams. We have not investigated them or needed to remediate them. If the Gulf of Finland is considered fresh-water (especially on coast of Helsinki) then the answer is yes as we have dredged some sediments, part of which we have also tried to drain: Some draining tests have been carried out with a perforated plastic "sock". Also one test was performed with drained sediment in basined area. Finally draining was tested using some solidifying agents and also without any solidifying agents (a long period of draining was used instead).

London: Not in the City of London.

Oslo: City of Oslo has not been performing any remediation of fresh-water sediments.

Stockholm: Sediments are rarely taken up unless we can not avoid moving them.

Vienna: There are no contaminated sediments in Vienna.

SUMMARY OF ANSWERS: Only Amsterdam and Copenhagen seems to have fresh-water sediments that are being drained (In Stockholm it also happens, however only very seldom). In Amsterdam they have much experience on the matter. In Copenhagen on the other hand, they struggle to find out what to do with the sediments (also after the draining process). In Helsinki, they have not been draining fresh-water sediments. They have however gained experience on draining sediments from the Gulf of Finland. In Hamburg they remove 3 to 4 million kubikmeters every year. The treatment varies.

Question E2: Are the fresh-water sediments remediated or deposited?

Amsterdam: Mostly the sediments are deposited (after dehydrating as much as possible)

Copenhagen: It would depend on the contents of pollutants. In Copenhagen, polluted sediments are often treated like polluted soils, so the same rules regarding remediation and depositing goes for the sediments as for the soils. It is a specific problem, that today we are not allowed to deposit soil containing more than 5 % TOC.

Hamburg: Non-contaminated dredged material and material with low levels of contamination is relocated in the River Elbe.

For a long-term solution, a sub-aquatic disposal option is being sought for dredged material that cannot be relocated in open water.

Higher contaminated dredged material is treated on land and depending on the circumstances reused or disposed.

The treatment on land: The contaminated silt is separated from the non-contaminated sand and dewatered. The sand can be used as building material, the silt is reused as sealing material or is disposed of in an environmentally friendly way. In general a portion of sediment gives 50 % of sand, 15 % of fine sand and 35 % of silt. On some occasions the silt has also been used for bricks.

Helsinki: There are 2 step guideline national values for depositing dredged materials to the sea. If concentration of dredged material is between level 1 and 2, dumping it to the sea is estimated case by case. If value 2 is exceeded, the sediment is rarely deposited in the sea (only if there is no better solution). Instead they are treated on land.

London: Not in the City of London.

Oslo: City of Oslo has not been performing any remediations of fresh-water sediments

Stockholm: If we take them up they are deposited on a deposit. Cleaning at site takes a permission. Dehydration takes a lot of space.

Vienna: There are no contaminated sediments in Vienna.

SUMMARY OF ANSWERS: In Amsterdam the sediments are most often deposited. This is also sometimes the case in Copenhagen. In Hamburg the contaminated, fine-textured fraction of the sediment is separated from the less contaminated sand-fraction. The sand can be reused afterwards. In Stockholm it is very seldom that freshwater sediments are removed. If they are, they are taken to soil deposits.

Question E3: In your city, do you have the same threshold values for contaminated fresh-water sediments as for contaminated soils?

Amsterdam: We have national threshold values for fresh-water sediments. The upper threshold values for sediments (or as we call it: soil under surface-water) are in general higher than the upper threshold values for dry soil.

Copenhagen: Yes.

Hamburg: -

Helsinki: Yes, if treated on land (See also the answer to E2).

London: If the sediments were to be dredged up and disposed of on land, then I expect we would look at them as a soil and assess them the same way.

Oslo: On a national level there is a division of freshwater sediments into classes depending on the content of heavy metals. They are not the same as for soil – generally they are lower compared to soil.

Stockholm: There are no guideline values for sediments. Just national classes based on soil conditions. Often we would use the guideline values for soil.

Vienna: -

SUMMARY OF ANSWERS: In Amsterdam they use national threshold values for fresh-water sediments. These are generally higher compared to threshold values for soil. Although the city of Oslo do not perform remediation of freshwater sediments, there are threshold values on a national level. These are generally lower compared to soil. In Copenhagen and Stockholm the threshold values/guideline values for polluted soil is applied.

F) Other Questions

Question F1: In Copenhagen we are investigating, whether it would be reasonable to measure the soil content of PCB7, Dioxins, Phthalates and Pesticides on a more regular basis. Do you have any contaminants in your city, that you are thinking about including in the evaluation of whether a soil is contaminated or not?

Amsterdam: In Amsterdam we have spots with a high level of arsenic in groundwater. This parameter is added to the standard pack of parameters in Amsterdam. The same for chloride in soil; this parameter appears in the deeper layers (old marine deposition). When these layers are being reused on surface there is a possibility that chloride affects the surface water.

Copenhagen: Yes, PCB7, Dioxins, Phthalates and Pesticides.

Hamburg: Contaminants, which are not regulated by national ordinances or other rules is evaluated in each individual case. Regardless of this, there is a continuous discussion on a national scale about a possible increase in the number of parameters that has to be regulated.

Helsinki: No, not at the moment anyhow

London: No. But we should be able to if we need to, based on the "significant possibility of significant harm" argument.

Oslo: Our Soil-classes already gives values for both PCB_7, dioxins and phthalates (DEHP).These were updated in 2009. At the moment no other subtances are on the verge of being included.

Stockholm: These elements are only investigated, if there is a suspicion that they might be there (based on knowledge on the former use of the area). I.e. on areas that has been used for greeneries.

Vienna: No.

SUMMARY OF ANSWERS: Copenhagen is currently investigating whether it would be reasonable to measure the soil content of PCB7, Dioxins, Phthalates and Pesticides on a more regular basis. In Oslo both PCB7, dioxins and phthalates are already measured (since 2009). In Stockholm these substances are being investigated only if there is a suspicion that they might be in the soil (based on for instance knowledge on site-use). In Germany there is an ongoing debate on a national scale about a possible increase in the number of parameters that has to be regulated. None of the other participating countries have plans for investigation of any other substances than the ones they are already investigating. In Amsterdam however focus is on arsenic (which locally can be high in groundwater) and chloride (which can be high in the deeper layers since this is old marine deposition).

Question F2: In your city, are you differentiating the naturally occurring hydrocarbons in soil from other hydrocarbons in the soil? If yes, how is it done? And does it have any impact on the handling of soil if a large fraction of the hydrocarbons are of natural sources?

Amsterdam: Yes, in some cases the oil content in the soil sample is blowed up by natural acid hydrocarbons (e.g. in peat). This is showed on chromatograms. Then no action has to be taken.

Copenhagen: When we are evaluating what the treatment of the soil should be, this is generally not taken into consideration. In a few cases, where it is known in advance that this soil contains high contents of natural hydrocarbons, we might ask the laboratory to give an estimation on this (based on Chromatography).

Hamburg: It is handled as it is in Copenhagen: When we are evaluating what the treatment of the soil should be, it is not taken into consideration. In a few cases, where it is known in advance that this soil contains high contents of natural hydrocarbons, we might ask the laboratory to give an estimation on this.

Helsinki: No

London: No

Oslo: No, normally we do not differentiate between naturally occurring hydrocarbons and other hydrocarbons. However on locations having high content of naturally occurring hydrocarbons – it can be taken into consideration.

Stockholm: No

Vienna: There are different parameters that must be measured when assessing the organic contamination (concentration in the soil pore air; in-situ concentrations in soil; concentration in soil ex-situ when the soil is being deposited or reused). TOC summarizes the overall situation regarding organic substances (both natural hydrocarbons and hydrocarbons that originates from contamination), a hydrocarbon-index (by means of Gas chromatography) is suited for measurement of the long-chained and heavy hydrocarbons having boiling point above 160 °C, Sum-of-hydrocarbons (by means of infra-red spectroscopy) is suited for the lighter fractions of hydrocarbons (having a boiling point from 30 to 180°C).

SUMMARY OF ANSWERS: Helsinki, London and Stockholm do not differentiate between the naturally occurring hydrocarbons in soil and other hydrocarbons in the soil when assessing the level of pollution. In Amsterdam, Hamburg, Oslo and Copenhagen it can be taken into consideration if it is known in advance that there might be high levels of naturally occurring hydrocarbons (for instance in peat). In these cases, the chromatograms are studied to estimate the portion of naturally occurring hydrocarbons. In Vienna they use different types of analyzes depending on whether the wish is to measure the long-chained hydrocarbons or the lighter fractions.

Question F3: How do you handle acute oil-spills on soil in your city?

Amsterdam: Due to our regulations you have to take action as soon as possible after the spill. In general all oil has to be removed.

Copenhagen: It will be removed instantly, as the contaminated soil will be isolated from the parts of the area, which is not yet contaminated. Afterwards it might be necessary to require analysis of the nearby area, to determine whether it is polluted or not.

Hamburg: It will be removed instantly, as the contaminated soil will be isolated from the parts of the area, which is not yet contaminated. Afterwards it might be necessary to require analysis of the nearby area, to determine whether it is contaminated or not.

Helsinki: First absorption material is spread over the spill; then oily soil is being "digged and dumped" right away. There are cases when the oil has already spread under buildings and remediation must be arranged using other methods (e.g. ventilation, sparging…)

London: With construction sites, we require that they plan to prevent spills, and that they respond appropriately by closing off drains/ using booms, using absorbent granules, stopping the leak at source etc. With road traffic accidents, we don't get involved.

Oslo: Acute oil-contamination is reported to the fire-department, who initiates the necessary action. This usually includes that anything fluent on top of the soil is sucked up, soil influenced by the spill is removed, and it is evaluated whether there is a possibility to make a biological treatment in-situ to remove any leftovers of the spill. Analyses is performed to make sure that the remediation was effective

Stockholm: Immediately the spill is covered by absorbent granules. The soil is dug up and taken to a soil deposit. Sampling focuses mainly on the borders of the hole to show that all the contamination has been removed.

Vienna: The action depends on the type and extension of the contamination: Either the soil is removed or the pore-air is sucked out of the soil and a dewatering of groundwater is performed. The soil on Hot-spots must be exchanged until the threshold values in an Austrian Standard are reached. An official expert within Water-attendance is responsible for the supervision when accidents like this take place in Vienna.

SUMMARY OF ANSWERS: All the cities generally respond in the same way when an acute oil spill happens: The soil that is affected by the spill is removed, and analyzes is done at the site to find out if all the affected soil have been removed.
But there are also local differences. London, Stockholm and Helsinki starts by spreading absorbent granules. In Oslo the spill is reported to the fire department, who initiates the nessecary action. After removal of the most affected soil, biological treatment in-situ might be used on the rest of the soil. Helsinki and Vienna also describes how the remediation can be done in other ways. For instance if the oil has spread far and perhaps under buildings, then ventilation, sparging etc. is used. Both Helsinki and Stockholm mentions the polluted soil is taken to soil deposits.

Question F4: Do you have threshold values for the content of mercury, methane, and chlorinated solvents in indoor and outdoor air on contaminated sites in your city? If yes, what are the threshold values?

Amsterdam: You can make difference between estimating the risks due to the contaminated soil (then we use a computer-model) and the contents you measure during the performance of the remediation work. Threshold values are respectively for Hg: 0,2 µg/m^3; methane: ?, vinylchloride (H2C:CHCl): 3,6 µg/m^3; trichlororethene (Cl2C=CHCl): 200 µg/m^3; tetrachlororethene (Cl2C=CCl2): 250 µg/m^3.

Copenhagen: The Environmental Protection Agency (under the Danish Ministry of the Environment) has issued a guidance-list, which indicates threshold values for evaporation, based on pore air measurements.

Hamburg: A German working group (Bund/Laender-Arbeitsgemeinschaft Bodenschutz (LABO)) evaluates orienting values for some special parameters; particular values are currently on the way.

Helsinki: There are national threshold values for indoor air in common - but not specially for outside sites. When risk assessment is made it includes the risk of inhaling the contaminants.

London: None specific to contaminated land, these would be driven by health and safety concerns.

Oslo: No, but indoor and outdoor concentrations are considered when performing a health based risk assessment. Risk is calculated using data input and standard values in a spread-sheet provided by the government.

Stockholm: No. For indoor-measurements there are no Swedish guidelines. Consultants sometime use the Danish guidelines. Swedish EPA refers to WHO regarding a calculation of reference-concentrations when it comes to risk-assessment.

Vienna: Threshold values for Methane and chlorinated solvents are described in an Austrian Standard. For Hg there are only MAC-values (Maximum allowable Concentration).

SUMMARY OF ANSWERS: London, Oslo, Stockholm and Helsinki do not have threshold values for mercury, methane, and chlorinated solvents in indoor and outdoor sites. Vienna has threshold values for Methane and Chlorinated solvents, whereas for Hg there are guideline values. In Germany a working group is focusing on deducing values for special parameters. Amsterdam has threshold values for Hg and a number of chlorinated solvents. In Denmark the Environmental Protection Agency has issued a guidance-list, which indicates threshold values for evaporation, based on pore air measurements.

Question F5: In Denmark the threshold values are mainly based on human toxicity. How are your threshold values set?

Amsterdam: Also mainly based on human toxicity and longterm exposure, but the threshold values are also based on ecological risks (poisoning ecological cycle).

Copenhagen: Based on Human Toxicity, where toxicity and exposure is taken into account. Also it is both taking acute and longterm exposure into account

Hamburg: In Germany the threshold values are deduced from human toxicology and/or ecotoxicological studies.

Helsinki: They are based both on ecological ("e") and human health risks (toxicological, "t"). See also appendix 1.

London: The soil guideline values (SGVs) are based on human toxicity - and also the probability of humans being exposed to the contamination. In addition to this, local authorities must decide whether a site presents a "significant possibility of significant harm". This requires a level of professional judgment.

Oslo: Threshold values in Norway are based on human health evaluations.

Stockholm: The Swedish EPA guideline describes “an acceptable low-risk-value” based on human toxicity

Vienna: The threshold values in Austria is also mainly based on human toxicity

SUMMARY OF ANSWERS: In London, Oslo, Stockholm and Vienna, the threshold values are also mainly based on human toxicity (and exposure). Amsterdam, Hamburg and Helsinki also include an ecological risk.

Appendix 1: Threshold values

Amsterdam:

The threshold values in the first three rows of table A1 are used in connection with reuse of soil. The soil content of pollutants decides the possible area-use. The last two rows hold threshold values to check if the soil should be remediated (all values are for a standard Dutch soil: lutite (sedimentary clastic rock with clay or silt grain size less than 0.06 mm) = 25%, humus = 10 %, these values are normally converted to the specific soil on the site). Upper and lower threshold value together with the size of the project decides the severity of the contamination.

Table A1: Threshold values for reuse of soil (first three rows) and remediation (last two rows) for soil in Amsterdam

Pollutant (mg/kg)	*Threshold value clean soil*	*Threshold value: suits for soil for residential use*	*Threshold value: suits for soil for industrial use*	*Threshold value, Lower*[1]	*Threshold value , Upper*[2]
As	*20*	*27*	*76*	*20*	*76*
Ba	*190*	*550*	*920*		
Pb	*50*	*210*	*530*	*50*	*530*
Cd	*0.6*	*1.2*	*4.3*	*0.6*	13
Cr (III)	*55*	*62*	*180*	*55*	*180*
Cr (VI)				*55*	78
Co	*15*	*35*	*190*		
Cu	*40*	*54*	*190*	*40*	*190*
Hg (org)	*0.15*	*0.83*	*4.8*	*0.15*	36
Hg (uorg)					4
Mo	*1.5*	*88*	*190*		
Ni	*35*	*39*	*100*	*35*	*100*
Zn	*140*	*200*	*720*	*140*	*720*
PAH(10)	*1.5*	*6.8*	*40*	*1.5*	40
Hydrocarbons	*190*	*190*	*500*	*190*	*5000*
PCB(7)	*0.02*	*0.02*	*0.5*		

[1]Natural background values
[2]Intervention values

Copenhagen:

Threshold values for depositing of soil in Copenhagen can be seen in table A2. In Copenhagen there are no soil deposits for clean soil (lower threshold value) and for hazardous waste, this is exported to other parts of the country. The upper threshold value indicates the upper limit for soil that can be deposited in the largest soil deposit in Copenhagen today.

Table A2: Threshold values for depositing of soil in Copenhagen

Pollutant	lower threshold value	upper threshold value	hazardous waste limit
	mg/kg		
As	20		
Pb	40	2500	2500
Cd	0.5	8.25	1000
Cr	500	5750	10000
Cu	500	40625	50000
Hg	1	22.5	500
Ni		262.5	1000
Zn	500	6625	50000
Benz(a)pyren	0.3		
Sum of 7 PAHs	4	75	
Hydrocarbons (C6-C40)		450	

Table A3 shows the values for reuse of soil in Copenhagen. Category 1 is often considered clean, and can be reused almost without restrictions. When it comes to Category 2 and 3 there are demands towards the size of projects and the distance to areas where groundwater is used for drinking water.

Table A3: Threshold values for reuse of contaminated soil in polluted soil in Copenhagen

	Concentration in soil (mg/kg)		
	Category 1	*Category 2*	*Category 3*
As	0 - 20	> 20	> 20
Pb	0 - 40	> 40	> 40
Cd	0 – 0.5	> 0.5	> 0.5
Cr, total	0 - 500	> 500	> 500
Cr (VI)	0 - 20	> 20	> 20
Cu	0 - 500	> 500	> 500
Hg	0 - 1	> 1	> 1
Ni	0 - 30	> 30	> 30
Zn	0 - 500	> 500	> 500
	Concentration in eluate (µg/l)		
Chloride	0 - 150000	0 - 150000	150000 - 3000000
Sulfat	0 - 250000	0 - 250000	250000 - 4000000
Na	0 - 100000	0 - 100000	100000 - 1500000
As	0 - 8	0 - 8	8-50
Ba	0 - 300	0 – 300	300 - 4000
Pb	0 - 10	0 - 10	10 - 100
Cd	0 - 2	0 - 2	2-40
Cr, total	0 - 10	0 - 10	10 - 500
Cu	0 - 45	0 - 45	45 - 2000
Hg	0 – 0.1	0 – 0.1	0.1 - 1
Mn	0 - 150	0 - 150	150 - 1000
Ni	0 - 10	0 - 10	10-70
Se	0 - 10	0 - 10	10 – 30
Zn	0 - 100	0 - 100	100 - 1500

Soil that is polluted above the values mentioned in the scheme below (table A4) should be remediated so that the content of contamination gets below the mentioned values.

Table A4: Values for remediation of polluted soil in Copenhagen

Compound	*Value (mg/kg)*
Hydrocarbons (C6-C10)	*50*
Hydrocarbons (C10-C20)	*100*
Hydrocarbons (C20-C35)	*300*
Total Hydrocarbons (C6-C35)	*300*
Sum of 7 PAH	*75*
2- and 3-ringed PAHs	*15*
Phenols	*70*
Cyanides	*1000*

Hamburg:

Threshold values for soil being deposited in Hamburg are shown in table A5. More precaution is to be taken with the higher classes (more claims towards sealing, drainage water etc). DKIII is a deposit class for hazardous waste.

Table A5: Threshold values for depositing of soil in Hamburg.

Pollutant	*DK 0*	*DK I*	*DK II*	*DK III*	*Unit*
loss on ignition	*3*	*3*	*5*	*10*	*%*
TOC	*1*	*1*	*3*	*6*	*%*
pH-value	*5,5 - 13*	*5,5 - 13*	*5,5 - 13*	*4 - 13*	
As	*0,05*	*0,2*	*0,2*	*2,5*	*mg/l*
Pb	*0,05*	*0,2*	*1*	*5*	*mg/l*
Cd	*0,004*	*0,05*	*0,1*	*0,5*	*mg/l*
Cr	*0,05*	*0,3*	*1*	*7*	*mg/l*
Cu	*0,2*	*1*	*5*	*10*	*mg/l*
Hg	*0,001*	*0,005*	*0,02*	*0,2*	*mg/l*
Ni	*0,04*	*0,2*	*1*	*4*	*mg/l*
Zn	*0,4*	*2*	*5*	*20*	*mg/l*
Ba	*2*	*5*	*10*	*30*	*mg/l*
Mo	*0,05*	*0,3*	*1*	*3*	*mg/l*
Sb	*0,006*	*0,03*	*0,07*	*0,5*	*mg/l*
Se	*0,01*	*0,03*	*0,05*	*0,7*	*mg/l*
PAK16	*30*				*mg/l*
Cyanide	*0,01*	*0,1*	*0,5*	*1*	*mg/l*
Phenol	*0,1*	*0,2*	*50*	*100*	*mg/l*
BTEX	*6*				*mg/kg*
PCB6	*1*				*mg/kg*
Chloride	*80*	*1500*	*1500*	*2500*	*mg/l*
Sulfate	*100*	*2000*	*2000*	*5000*	*mg/l*
Fluoride	*1*	*5*	*15*	*50*	*mg/l*
Hydrocarbons (C10 - C40)	*500*				*mg/kg*

Threshold values for soil being reused in Hamburg (Table 6A6). Soil that is contaminated above the Z2-value must be deposited (or needs a special permission for reuse). The higher categories have more claims towards especially the sealing of the projects. But also there are claims towards the distance to ground water.

Table A6: Threshold values for reuse of soil in Hamburg

Pollutant	*Z0*[1]	*Z0**	*Z1*	*Z2*	*Unit*
As	*2-20*	*15*	*45*	*150*	*mg/kg*
Pb	*40 - 100*	*140*	*210*	*700*	*mg/kg*
Cd	*0,4 - 1,5*	*1*	*3*	*10*	*mg/kg*
Cr	*30 - 100*	*120*	*180*	*600*	*mg/kg*
Cu	*20 - 60*	*80*	*120*	*400*	*mg/kg*
Hg	*0,1 - 1*	*1*	*1,5*	*5*	*mg/kg*
Ni	*15 - 70*	*100*	*150*	*500*	*mg/kg*
Zn	*60 - 200*	*300*	*450*	*1500*	*mg/kg*
Tl	*0,4 - 1*	*0,7*	*2,1*	*7*	*mg/kg*
Cyanid			*3*	*10*	*mg/kg*
TOC	*0,5 / 1*	*0,5 / 1*	*1,5*	*5*	*%*
EOX	*1*	*1*	*3*	*10*	*mg/kg*
PAK16	*3*	*3*	*3 (9)*	*30*	*mg/kg*
Benz(a)pyren	*0,3*	*0,6*	*0,9*	*3*	*mg/kg*
Hydrocarbons	*100*	*200 (C10 - C22)* *400 (C10 - C40)*	*300 (C10 - C22)* *600 (C10 - C40)*	*1000 (C10 - C22)* *2000 (C10 - C40)*	*mg/kg*
BTX	*1*	*1*	*1*	*1*	*mg/kg*
LHKW	*1*	*1*	*1*	*1*	*mg/kg*
PCB6	*0,05*	*0,1*	*0,15*	*0,5*	*mg/kg*
pH-value	*6,5 - 9,5*	*6,5 - 9,5*	*6,5 - 9,5 /6-12*	*5,5 - 12*	
conducivity	*250*	*250*	*250 / 1500*	*2000*	*µS/cm*
As	*14*	*14*	*14 - 20*	*60*	*µg/l*
Pb	*40*	*40*	*40 - 80*	*200*	*µg/l*
Cd	*1,5*	*1,5*	*1,5 - 3*	*6*	*µg/l*
Cr	*12,5*	*12,5*	*12,5 - 25*	*60*	*µg/l*
Cu	*20*	*20*	*20 - 60*	*100*	*µg/l*
Hg	*< 0,5*	*< 0,5*	*< 0,5 - 1*	*2*	*µg/l*
Ni	*15*	*15*	*15 - 20*	*70*	*µg/l*
Zn	*150*	*150*	*150 - 200*	*600*	*µg/l*
Phenol	*20*	*20*	*20 - 40*	*100*	*µg/l*
Cyanid	*5*	*5*	*5-10*	*20*	*µg/l*
Chloride	*30*	*30*	*30 - 50*	*100*	*mg/l*
Sulfate	*20*	*20*	*20 - 50*	*200*	*mg/l*

[1]Depending on the soil texture. The lower value in the interval goes for sandy soils, the higher values for clay

*A special class for filling of gravel pits

Helsinki:

The threshold values originate from the *Finnish Government Decree on the Assessment of soil Contamination and Remediation Needs* (214/2007). The decree states that soil contamination and soil remediation needs must be assessed if the concentration of one or several harmful substances in the soil exceeds the threshold values in table A7.
Soil is regarded as contaminated (in most cases): 1) in an area used as an industrial, storage or transport area or as other corresponding area if the concentration of one substance or several substances exceeds the prescribed upper guideline value. 2) in other areas if the concentration of one substance or several substances exceeds the prescribed lower guideline value. Values for metals are for standard soil (lulite= 25%; humus=10%). If the soil is very different the values are corrected, taking this into account.

In practice the main principle regarding depositing/reuse of soil is: Up to threshold value = free to use. Up to lower guideline value = usually valid for reuse on yards or otherwise taken to soil deposits. Up to upper guideline value = cover-layer (reuse) on landfills.

Table A7: Threshold values for contaminated soil in Helsinki. (t) indicates that the value is based on a health risk; (e) means that the value is based on an ecological risk; (p) means that the risk of groundwater contamination is higher than normal at concentrations below the lower guideline value.

Substance	Natural Concentration	Threshold value	Lower guide-line value	Upper guide-line value
	mg/kg TS			
Metals and semimetals				
Antimony (Sb) (p)	0,02 (0,01-0,2)	2	10 (t)	50 (e)
Arsenic (As) (p)	1 (0,1-25)	5	50 (e)	100 (e)
Mercury (Hg)	0,005 (< 0,005-0,05)	0,5	2 (e)	5 (e)
Cadmium (Cd)	0,03 (0,01-0,15)	1	10 (e)	20 (e)
Cobalt (Co) (p)	8 (1-30)	20	100 (e)	250 (e)
Chrome (Cr)	31 (6-170)	100	200 (e)	300 (e)
Copper (Cu)	22 (5-110)	100	150 (e)	200 (e)
Lead (Pb)	5 (0,1-5)	60	200 (t)	750 (e)
Nickel (Ni)	17 (3-100)	50	100 (e)	150 (e)
Zinc (Zn)	31 (8-110)	200	250 (e)	400 (e)
Vanadium (V)	38 (10-115)	100	150 (e)	250 (e)
Other inorganic				
Cyanide (CN)		1	10	50
Aromatic hydrocarbons				
Benzene (p)		0,02	0,2 (t)	1 (t)
Toluene (p)			5 (t)	25 (t)
Ethylbenzene (p)			10 (t)	50 (t)
Xylenes			10 (t)	50 (t)
TEX		1		
Chlorinated aliphatic hydrocarbons				
Dichloromethane (p)		0,01	1 (t)	5 (t,e)
Vinyl chloride (p)		0,01	0,01 (t)	0,01 (t)
Dichloroethenes(p)		0,01	0,05 (t)	0,2 (t)
Trichloroethene (p)		0,01	1 (e,t)	5 (e)
Tetrachloroethene (p)		0,01	0,5 (t)	2 (t)

Table A7 Continued.

Substance	Natural Concentration	Threshold value	Lower guide-line value	Upper guide-line value
	mg/kg TS			
Polycyclic aromatic hydrocarbons				
Anthracene		1	5 (e)	15 (e)
Benzo(a)anthracene		1	5 (e)	15 (e)
Benzo(a)pyrene		0,2	2 (t)	15 (e)
Benzo(k)fluoranthene		1	5 (e)	15 (e)
Phenanthrene		1	5 (e)	15 (e)
Fluoranthene		1	5 (e)	15 (e)
Naphthalene		1	5 (e)	15 (e)
PAH		15	30 (e)	100 (e)
Polychlor. biphenyls (PCB) and polychlor. dibenzo-p-dioxins and furans (PCDD/F)				
PCB		0,1	0,5 (t)	5 (e)
PCDD-PCDF-PCB		0,00001	0,0001 (t)	0,0015 (e)
Chlorobenzenes				
Trichlorobenzenes		0,1	5 (t)	20 (e)
Tetrachlorobenzenes		0,1	1 (t)	5 (e)
Pentachlorobenzene		0,1	1 (t)	5 (e)
Hexachlorobenzene		0,01	0,05 (t)	2 (e)
Chlorophenols				
Monochlorophenols		0,5	5 (e,t)	10 (e)
Dichlorophenols		0,5	5 (t)	40 (e)
Trichlorophenols		0,5	10 (e,t)	40 (e)
Tetrachlorophenols		0,5	10 (e,t)	40 (e)
Pentachlorophenol (p)		0,5	10 (e,t)	20 (e)
Pesticides and biocides				
Atrazine (p)		0,05	1 (e)	2 (e)
DDT-DDD-DDE		0,1	1 (e)	2 (e)
Dieldrin		0,05	1 (e)	2 (e)
Endosulphan		0,1	1 (e)	2 (e)
Heptachlorine		0,01	0,2 (t)	1 (e)
Lindane (p)		0,01	0,2 (t)	2 (e)
TBT-TPT		0,1	1 (e)	2 (e)
Petroleum hydrocarbon fractions and oxygenates				
MTBE-TAME		0,1	5 (t)	50 (t)
Petrol fractions (C5-C10)			100	500
Middle distillates (>C10-C21)			300	1000
Heavy petroleum fractions (>C21-C40)			600	2000
Petroleum fractions (>C10-C40)		300		

London:

There are different Soil Guideline Values (SGVs) depending on land-use (residential, allotments, commercial) since people use land differently and this effect who and how people may be exposed to soil contamination.

SGV are criteria which help to assess human health risk from long-term exposure to chemical contamination in soil. They act as 'trigger values' for assessing whether concentrations of chemicals in soil **may** pose a possibility of significant harm to human health. They give an indication of representative average levels of chemicals in soil below which the long-term health risks are likely to be minimal. Exceeding an SGV does not mean that remediation is always necessary, although in many cases some further investigation and evaluation of the risk will be carried out.

Professionals and regulators assessing risks to health from land contamination are **not required** (by legislation) to use SGV and the supporting technical guidance. Alternative approaches can be used provided that they satisfy the legislative requirements."

Table A8: Soil Guideline values for contaminated soil in London.

	Residential use	Allotment	Commercial use
	mg/kg DW		
Arsenic	32	43	640
Nickel	130	230	1800
Mercury, elemental	1.0	26	26
Mercury, Inorganic	170	80	3600
Mercury, Organic	11	8	410
Selinium	350	120	13000
Cadmium	10	1.8	230
Benzene	0.33	0.07	95
Toluene	610	120	4400
Ethylbenzene	350	90	2800
O-Xylene	250	160	2600
m-xylene	240	180	3500
p-xylene	230	160	3200
∑dioxins, furans and dioxinlike-PCB[1]	8	8	240
Phenol	420	280	3200

[1]2,3,7,8-TCDD; 1,2,3,7,8-PeCDD; 1,2,3,4,7,8-HxCDD; 1,2,3,6,7,8-HxCDD; 1,2,3,7,8,9-HxCDD; 1,2,3,4,6,7,8-HpCDD; OCDD; 2,3,7,8-TCDF; 1,2,3,7,8-PeCDF; 2,3,4,7,8-PeCDF; 1,2,3,4,7,8-HxCDF; 1,2,3,7,8,9-HxCDF; 1,2,3,6,7,8-HxCDF; 2,3,4,6,7,8-HxCDF; 1,2,3,4,6,7,8-HpCDF; 1,2,3,4,7,8,9-HpCDF; OCDF; 3,3',4,4'-TCB (PCB-77) ; 3,4,4',5-TCB (PCB-81); 3,3',4,4',5-PeCB (PCB-126); 3,3'4,4'5,5'-HxCB (PCB-169); 2,3,3'4,4'-PeCB (PCB-105); 2,3,4,4',5-PeCB (PCB-114); 2,3',4,4',5-PeCB (PCB-118); 2,3,4,4',5-PeCB (PCB-123); 2,3,3',4,4',5-HxCB (PCB-156), 2,3,3',4,4',5'-HxCB (PCB-157); 2,3',4,4',5,5'-HxCB (PCB-167); 2,3,3',4,4',5,5'-HpCB (PCB-189)

Oslo:

National threshold values for contaminated soil in Norway (in mg/kg DW) are shown in table A9. The values are divided into 5 classes. These classes also describe the possible area-use.

Table A9: Threshold values for contaminated soil in Oslo

Soil Class/contaminants (in mg/kg)	1 Very Good	2 Good	3 Moderate	4 Bad	5 Very bad
Arsenic	< 8	8-20	20-50	50-600	600-1000
Lead	< 60	60 -100	100-300	300-700	700-2500
Cadmium	<1.5	1.5-10	10-15	15-30	30-1000
Mercury	<1	1-2	2-4	4-10	10-1000
Cupper	< 100	100-200	200-1000	1000-8500	8500-25000
Zink	<200	200-500	500-1000	1000-5000	5000-25000
Chromium (III)	<50	50-200	200-500	500-2800	2800-25000
Chromium (VI)	<2	2-5	5-20	20-80	80-1000
Nickel	< 60	60- 135	135-200	200-1200	1200-2500
PCB7	< 0.01	0.01-0.5	0.5-1	1-5	5-50
DDT	<0.04	0.04-4	4-12	12-30	30-50
PAH16	<2	2-8	8-50	50-150	150-2500
Benzo(a)pyren	< 0.1	0.1-0.5	0.5- 5	5-15	15-100
Alifats C8-C10	< 10	<10	10-40	40-50	50-20000
Alifats > C10-C12	< 30	30- 60	60-130	130-300	300-20000
Alifats > C12-C35	< 100	100-300	300-600	600-2000	2000-20000
DEHP	<2.8	2.8-25	25-40	40-60	60-5000
Dioxins/furans	<0.00001	0.00001-0.00002	0.00002-0.0001	0.0001-0.00036	0.00036-0.015
Fenol	<0.1	0.1-4	4-40	40-400	400-25000
Benzen	<0.01	0.01-0.015	0.015-0.04	0.04-0.05	0.05-1000
Trichlorethene	<0.1	0.1-0.2	0.2-0.6	0.6-0.8	0.8-1000
allowed area-use:	All area-uses	-Dwelling -Kindergartens -Parks -Other sensitive area-use	-City-Center -Offices -Stores	-Industry -Traffic (roads etc)	Only accepted in unsensitive areas after a risk-based estimation of the spreading of contaminants.

Stockholm:

The Swedish Environmental Protection Agency gives guideline values for two types of area use: Sensitive area-use (KM) and less sensitive area use (MKM). At the sensitive area use, the values in table A10 are set to ensure that all groups of people (kids, adults, older people) can live at the site for an entire lifespan. The less sensitive areas should mainly be used for office-buildings, industry or roads. The values are also used in connection to reuse.

Table A10: Threshold values for contaminated soil in Stockholm.

Contaminant (mg/kg)	KM	MKM	Comment
Antimon	12	30	
Arsenic	10	25	
Barium	200	300	
Lead	50	400	
Cadmiun	0.5	15	
Cobolt	15	35	
Cupper	80	200	
Chromium (total)	80	150	Cr (VI) should also be taken into consideration If Cr (VI) is higher than 1% of the total Cr-content
Chromium (VI)	2	10	Comment 2
Mercury	0.25	2.5	
Molybden	40	100	
Nickel	40	120	
Vanadium	100	200	
Zinc	250	500	
Cyanid total	30	120	
Cyanid (mobile)	0.4	1.5	Comment 2
Sum of phenol och cresoles	1.5	5	Comment 2
Sum of chlorphenoles (mono - penta)	0.5	3	Comment 2
Sum of mono- och dichlorbenzenes	5	15	Comment 1+2
Trichlorbenzenes	1	10	
Sum of tetra- och pentachlorbenzenes	0.5	2	
Hexachlorbenzene	0.035	2	
Dichlormetane	0.08	0.25	Comment 1+2
Dibromchlormetane	0.5	2	Comment 1+2
Bromdichlormetane	0.06	1	Comment 1+2
Trichlormetane	0.4	1.2	Comment 1+2
Koltetraklorid (Tetraklormetan)	0.08	0.35	Comment 1+2
1,2-dichloretane	0.02	0.06	Comment 1+2
1,2-dibrometane	0.0015	0.025	Comment 1+2
1,1,1-trichloretane	5	30	Comment 1+2
Trichloretene	0.2	0.6	Comment 1+2
Tetrachloretene	0.4	1.2	Comment 1+2

Table A10 Continued

Contaminant (mg/kg)	KM	MKM	Comment
Dinitrotoluen (2,4)	0.05	0.5	Comment 2
PCB-7	0.008	0.2	PCB-7 is assumed to be 20 % of PCB-tot
Dioxin (TCDD-ekv WHO-TEQ)	0.00002	0.0002	also includes dioxin-like PCB
PAH L	3	15	PAH with low molecular weight
PAH M	3	20	PAH with medium molecular weight
PAH H	1	10	PAH with high molecular weight
Benzene	0.012	0.04	Comment 1+2
Toluen	10	40	Comment 1+2
Ethylbenzene	10	50	Comment 1+2
Xylen	10	50	Comment 1+2
Alifat >C5-C8	12	80	Comment 1+2
Alifat >C8-C10	20	120	Comment 1
Alifat >C10-C12	100	500	Comment 1
Alifat >C12-C16	100	500	
Alifat >C5-C16	100	500	
Alifat >C16-C35	100	1000	
Aromat >C8-C10	10	50	
Aromat >C10-C16	3	15	
Aromat >C16-C35	10	30	
MTBE	0.2	0.6	Comment 1+2

Comment 1: Contaminants that to a large degree can be found in the soil pore air. Additional analyses of indoor and outdoor air are recommended. Comment 2: Contaminants that to a large degree can be found in the groundwater. Additional analyses of the groundwater are recommended.

Table A11: Soils having a content of contaminants below the values in the following scheme can be reused without restrictions.

Pollutant	Threshold value (mg/kg TS)
As	10
Pb	20
Cd	0,2
Cr	40
Cu	40
Hg	0,1
Ni	35
Zn	120
Benz(a)pyren	
Hydrocarbons	
PAH-L	0,6
PAH-M	2
PAH-H	0,5

Vienna:

Table A12 shows the threshold values for soils that can be reused without restrictions (called Class A1). The threshold values differ depending on whether the soil texture is sand, clay or a mixture between sand, silt or clay (mixed texture).

Table A12: Threshold values for soils that can be reused without restrictions in Vienna.

	Sandy soil	Mixed texture	Clay soil
	mg/kg DW		
As	20	20	20
Pb	30	50	70
Cd	0.5	0.7	1.1
Cr (III + VI)	40	40	70
Cu	30	30	40
Ni	30	30	50
Hg	0.2	0,3	0.7
Zn	100	100	140
∑Hydrocarbons	20/50/100/200[1]		
∑PAH (16 US-EPA)	2		
Benz[a]pyren	0.2		
BTEX	0.1		
PCB (6)	0.1		
AOX[2] (as Cl)	0.3		

[1]With: TOC-content ≤ 0.3 % **OR** 0.3 % < TOC ≤ 0.5% **OR** 0.5% < TOC ≤ 2 % **OR** TOC > 2 %
[2]Adsorbable organic halogen

Table A13 (Class A2) shows the threshold values for soil that can be reused with some restrictions (must only be used as subsoil). Here there is no division based on the soil texture. There are also threshold values for the part of pollution that can be leached for a number of substances. If the soil in class A2 are to be used in areas where the groundwater is used for drinking water there are additional threshold values that must be met.

Table A13: Threshold values for soils that can be reused with some restrictions in Vienna. The second part of the scheme show additional components to be measured, if the soil is reused in areas where the groundwater is used for drinking water.

	Total content	**Leachable part**
	mg/kg TS	mg/kg TS
As	30	0.3
Pb	100	0.3
Cd	1.1	0.03
Cr	90	0.3
Co	30	0.5[3]
Cu	60/90[1]	0.6
Ni	55	0.6
Hg	0.7	0.01
Zn	300/450[1]	18
∑Hydrocarbons	20/50/100/200[2]	5-13

Table A13 continued

	Total content	Leachable part
	mg/kg TS	mg/kg TS
∑PAH (16 US-EPA)	2	0,023
Benz[a]pyren	0,2	
BTEX	1	0,33
PCB (6)	0,1	0,0053
AOX (as Cl)		0,3
Anionic tensides		13
TOC	5000	1003
Phenolindex		0,053
Following also measered in areas where groundwater is used for drinkingwater		
pH-value		6.5-9.5
Electric conductivity		50
Al		5
Sb		0.1
Ba		5
Be		0.05
B		5
Cr		0.2
Fe		5
Mn		0.5
Se		0.1
Ag		0.2
Tl		0.1
V		0.5
Sn		0.5
NH_4^+		1
NO_3^-		70
NO_2^-		0.5
Cyanide, Volatile		0.1
Cyanide, Total		0.1
F		15
Cl		1000
PO_4^{3-}		1
SO_4^{2-}		1500

[1]For soil with pH >7 the higher value applies (however not in areas where groundwater is used for drinking water)
[2]With: TOC-content ≤ 0.3 % **OR** 0.3 % < TOC ≤ 0.5% **OR** 0.5% < TOC ≤ 2 % **OR** TOC > 2 %
[3]Only needs to be measured in areas where groundwater is used for drinking water

There are separate threshold values for reuse of soil that has a natural high background value. These are not shown here but can be downloaded at: http://www.bundesabfallwirtschaftsplan.at/
For the soil that is being deposited, another set of threshold values are used (table A14). The content of pollutants in the soil decides what type of soil deposit, the soil is taken to.

Table A14: Threshold values for soil that is being deposited in Vienna.

Parameter/type of deposit	**Bodenaushub**[1]	**Inert waste**	**Baurestmassen**	**Reststoff**	**Massenabfall**
	Threshold value (mg/kg DW)				
As	50	200	200	5000	500
Pb	150	500	500		5000
Cd	2	4	10	5000	30
Cr (total)	300	500	500		8000
Co	50	50	100		500
Cu	100	500	500		5000
Ni	100	500	500		2000
Hg	1	2	3	20	20
Zn	500	1000	1500		5000
TOC	30000	30000	30000	50000	50000
Hydrocarbons	50/100/200[2]	500	1000	5000	20000
PAH (16 US EPA)	4	20	30	300	300
Benz(o)apyrene	0.4	2			
PCB_7		1			
BTEX	6	6	6	6	6

[1]For the inorganic contaminants there are another (higher) set of threshold values if the contamination is geogenic (As = 200 mg/kg; Pb = 500 mg/kg; Cd = 4 mg/kg; Cr = 500 mg/kg; Ni = 500 mg/kg; Hg = 2; Zn = 1000).
[2]With: TOC-content $\leq$ 0.5 % **OR** 0.5 % < TOC $\leq$ 2 % **OR** TOC > 2 %

There are also threshold values for concentration in eluates when it comes to depositing of soil, these are not shown here, but can be found at: http://www.fmmi.at/uploads/media/Anhang1_deponie.pdf

The following table A15 holds values for remediation of soil. At levels above the values (Massnahmen-Schwellenwerte), action has to be taken. Massnahmen-Schwellenwerte only exists for very few components. However there are values (Prüfwerte) for a wider range of components, the Prüfwerte indicates that further investigations have to be done.

Table A15: Values for remediation of soil in Vienna

Contaminant	
Sum of hydrocarbons[1]	500 mg/kg
Hydrocarbon-index	500[2]/1000[3] mg/kg
Sum of PAHs	100 mg/kg

[1]With a boiling point of 30-180 °C
[2]With a boiling point between 160°C and 300°C
[3]Mainly with a boiling point above 300 °C and determined by Gaschromatographic measurements

There are also threshold values for contaminants in eluate and air in soil-pores. These are not shown here, but can be found in *norm S2088-1: Altlasten – Gefärdungsabschätzung für das Schutzgut Grundwasser*.