



ISLANDR Roadmap

Part 4: Diffuse contamination

Document information

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Summary

This deliverable gives a summary description of the ISLANDR Roadmap journey of diffuse contamination. The ISLANDR Roadmap is a decision-making tool designed to support users engaged in contaminated site management and land redevelopment. Recognising the complexity of the remediation process, the roadmap does not prescribe a rigid set of steps but instead offers structured guidance to navigate key decisions. While it cannot map every possible choice in advance, it provides a clear direction to help users make informed and effective decisions. Adaptable to different contexts, the roadmap can be tailored to deliver user-specific insights, ensuring relevance and practical value for diverse remediation projects. The Roadmap consists of three journeys: single sites, portfolio of sites and diffuse soil contamination, and those journeys are described in separate reports.

Keywords

Sustainable Risk-based Land Management, diffuse contamination, brownfields, soil health, circularity, low input remediation, contaminants of emerging concern, wider benefits, wider value, spatial planning, ISLANDR Roadmap

Abbreviations and acronyms

Acronym	Description
CEC	Contaminants of emerging concern
CSM	Conceptual Site Model
PRA.MS	Preliminary Risk Assessment Model for the identification and assessment of problem areas for Soil contamination in Europe European Commission
SPR	Source, pathway, receptor

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ISLANDR project in brief

The Information-based Strategies for Land Remediation, in short ISLANDR, is a multidisciplinary project, which is foremost aimed at supporting the execution of the EU mission: A Soil Deal for Europe.

More specifically, the ISLANDR research activities are designed to provide tools and methods so as to support: (1) the delineation of polluted soils across Europe, (2) an evidence-based assessment of the risks posed by polluted soils, (3) the promotion of sustainable and risk-based land management practices, (4) the inclusion of a wider valuation approach in financial and investment cases, and (5) a closer integration of land contamination and spatial planning decision-making. Lessons learnt and experience gained throughout the project duration will be used to (6) deliver key policy-relevant findings related to the Soil Strategy, the new Soil Health Law, and other areas of policy where soils are crucial.

In order to road-test the project's findings, seven test areas across Europe have been identified. To begin with, the ISLANDR Test Areas (ITAs) will provide a real-world context for the planned research activities. More concretely, the ITAs have been selected to cover different land use types, such as urban, peri-urban, rural, agro-forestry, mining, wetlands and coastal areas. Furthermore, the ITAs are characterized by both point source and diffuse pollution, as well as by different soil pollution types, such as organic, inorganic, as well as contaminants of emerging concern.

Furthermore, ISLANDR brings a dedicated focus to low input remediation, by including test areas impacted by the consequences of the green transition, such as former mining areas. This will ensure that soil remediation will be facilitated even when the cost of remediation is economically marginal or may even be negative. On the one hand, this necessitates a more thorough understanding of low input remediation approaches from a technological perspective, yet it also requires a wider value proposition for investment cases and financial planning.

Key actors, stakeholders and end-beneficiaries are at the epicentre of ISLANDR. Through roundtables in the respective ITAs, the foremost assignment of local actors will be to provide feedback and offer insights as to the robustness and effectiveness of the strategies, frameworks and decision-support tools, as well as on the wider valuation approaches and financing mechanisms to be developed over the course of the project's lifetime. Thus, the Roundtables are foreseen to bring an iterative feedback loop to the research process, with a view to ensure the wider uptake of the project's outcomes and achievements.

Last but not least, local communities in the respective ITAs will be invited to participate in a survey organized both during the early stages and towards the end of the project, as a means to document soil literacy among society thereby bringing insight as to whether the exposure of society to the project's activities on the ground can bring about a strongly desired 'awareness pull' to the benefits to be reaped from healthy soils, thereby leveraging society at large to subscribe to the projects' motto: ISLANDR for Soil Health!

Introduction

The ISLANDR Roadmap is a decision-making tool designed to support users engaged in contaminated site management and land redevelopment. Recognising the complexity of the remediation process, the roadmap does not prescribe a rigid set of steps but instead offers structured guidance to navigate key decisions. While it cannot map every possible choice in advance, it provides a clear direction to help users make informed and effective decisions. Adaptable to different contexts, the roadmap can be tailored to deliver user-specific insights, ensuring relevance and practical value for diverse remediation projects.

This report provides a description of all the activities that are part of the diffuse contamination journey roadmap (table 1).

Table 1. Overview of the different activities per phase, under the diffuse contamination journey

Triggers for diffuse soil contamination survey: Region is under development (e.g. new land use plan in cities or in regional agricultural development needs); Need to protect a natural resource (e.g. groundwater); Identification of a type of activity that is known to produce diffuse contamination; New legislation (e.g., Member State specific demands); Research on regions / (emerging) contaminants shows level of contamination above permitted thresholds.

Identification phase

Define regions with potential diffuse contamination

Vision/Initiative phase

Preliminary regional characterisation

Regional risk assessment

Focused risk assessment (if needed) (jump to Journey 1)

Exploring preliminary business cases

Planning

Explore and assess strategies to find the most suitable approach

Adapt existing regulations (e.g. limit the type of crop in agricultural sites so it does not include edibles, excavated soils and their use)

Identify whether there are specific areas that need remediation (jump to Journey 1)

(Re)development strategies

Control the source

Redevelopment plan

Realisation

Living with diffuse contamination with reduced risk

Maintenance

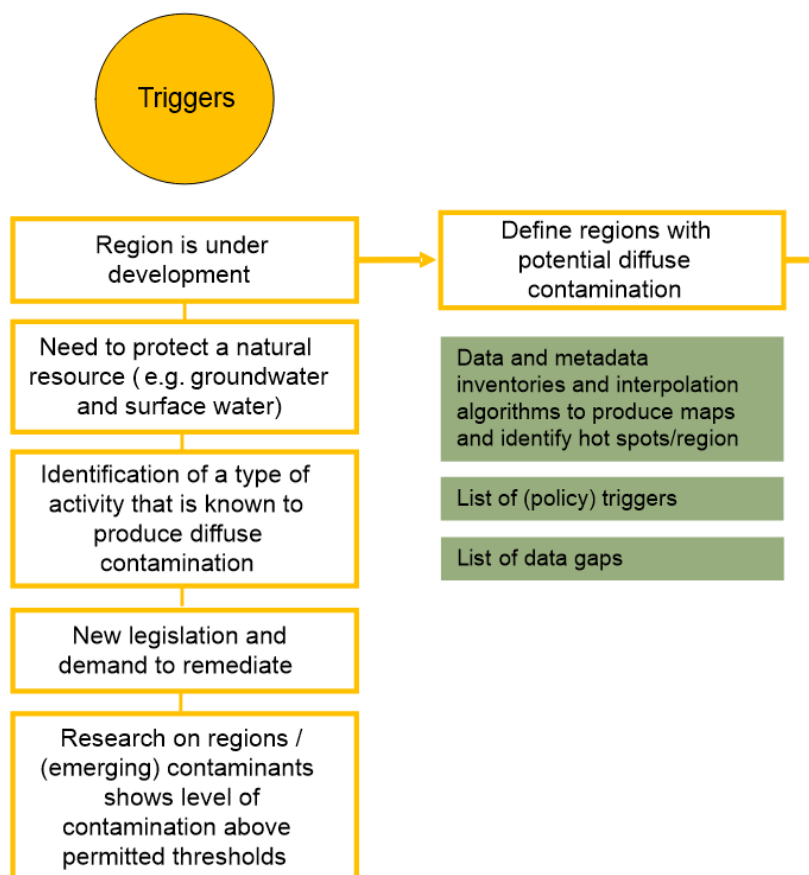
Monitoring

1. Identification

During this phase, a region with potential diffuse contamination is identified. The areas for further planning are defined and characterised. ISLANDR provides building blocks on inventories and interpolation algorithms to identify contaminated regions, list of data gaps and list of policy triggers.

The identification is triggered, e.g. if the region is under development, either by land use change or due to growing population, or for example when a need to protect a natural resource is identified. Sometimes an activity that produces diffuse contamination is identified and it needs to be controlled, or there might be new legislation that demands actions, e.g. Soil Monitoring Law. Sometimes also regular monitoring activities may reveal diffuse contamination.

IDENTIFICATION



1.1. Triggers for diffuse soil contamination survey

There are several different types of triggers for delineating potential diffuse soil contamination areas, for preliminary risk assessment and for development of land use cases. Table 2 shows examples of triggers.

Table 2. Potential triggers of remediation for diffuse soil contamination.

Trigger	Description
Region is under development	Typically, diffuse pollution is detected within a city or a region, that has a need to develop new areas or redevelop and change land use within the city. During a sampling campaign, diffuse pollution is then detected as a contaminant or a group of contaminants, that are often detected in the soil, but which do not always need remediation. Rather they degrade the soil quality and may limit the soil use for some land uses or make it less than optimal in the intended use. Such cases could be agricultural production or sensitive land use like school yard or children's daycare.

Need to protect a natural resource (e.g. groundwater and surface water)	Aquifers are typically strictly protected from effects that may cause harm to their water quality or quantity. If a new water intake plant is planned for an area, all risks to these should be mapped and controlled, including diffuse contamination. Surface water is protected under the Water Framework Directive which places requirements on reaching ecological outcomes. Runoff from diffuse contaminated land may compromise this.
Identification of a type of activity that is known to produce diffuse contamination	An activity's effects to the larger environment are studied for monitoring purposes or out of other interest, for example when selling a property or during a due diligence process. The activity can be either historical or current, but the findings may lead to identification of an area with diffuse contamination.
New legislation and demand to remediate	New legislation (regional, national, EU-wide) may introduce new elements and substances to the list of monitored contaminants. This may trigger a need to conduct a soil survey for a larger geographical area.
Research on regions / (emerging) contaminants shows level of contamination above permitted thresholds	If a contaminant is found in soil during any excavation work in concentration above a threshold value that demands further studies, this may trigger a survey for a larger area or region, especially if no clear point of pollution or other clear source can be identified. This might be the case for several emerging contaminants like PFAS, that is known to be found in several environmental media.

1.2. Define regions with potential diffuse contamination

This part of the identification phase concerns assessing the areal concentrations of identified contaminants against their respective background concentrations. The background information can be acquired from publicly available datasets or use existing data and algorithms to produce maps for hot spot identification.

National legislation or EU-level guidelines and directives may also impose policy triggers, that demand the area to be identified and potential risks to the environment, human health and, further to adoption of the Soil Monitoring Law, soil health, to be taken into consideration.

There are, however, gaps in our knowledge and data available on soils. For some known contaminants there are no acceptable or natural background concentrations, or there is not enough knowledge on their effects to soil health. In these cases, case-specific sampling should be considered to fill in the gaps. Common data gaps are made available by ISLANDR.

Building block

Data and metadata inventories and interpolation algorithms to produce maps and identify hotspots/region

Publicly available EU-wide, national and regional databases were collected for diffuse soil contamination by ISLANDR during the years 2023-2024. The full list of found databases can be accessed through the metadata catalogue (see link below). Diffuse soil contamination databases are rare and the review on the European diffuse soil contamination databases also included geochemical mapping and monitoring databases. ISLANDR provides a metadata catalogue of these European databases describing local and diffuse soil contamination. ISLANDR provides an algorithm for the recognition of potentially contaminated anomalous hot spots. Once these hot spots have been removed from the dataset, a map of diffuse pollution can be produced, which is a simple and a very effective form of filtering. The interpolator used in anomaly detection and for diffuse mapping can work with scattered, uncertain data and clusters that are commonly encountered in our databases and test areas. This is a new way to find diffuse soil contamination anomalies and potentially contaminated single sites. The algorithm is also useful for identifying pedogeochemical background values, which are important for the application of the healthy soil criteria of Annex I of the Directive on Soil Monitoring and Resilience.

Please find more information on databases on local and diffuse soil contamination from the ISLANDR D1.1 Data summary - Overview of Soil Pollution in Europe [Link]

Please read more on the interpolation algorithm and hot spot recognition from the ISLANDR D1.2 Hot spot identification [Link]

The ISLANDR D1.2 algorithm is available as a binary R package [iisdia_1.0.zip]

The algorithm and its scientific bases are described in: Belbèze, S., Rohmer, J., Guyonnet, D., Négrel, Ph., Tarvainen, T. 2025. Improving spatial interpolation for anomaly analysis in presence of sparse, clustered or imprecise data sets. Journal of Geochemical Exploration, 279, 107868.

The ISLANDR Metadata Catalogue is available from [Link]

Building block

List of (policy) triggers

Relevant directives and regulations in the identification phase of the ISLANDR roadmap include the Soil Monitoring and Resilience Directive (SML), Industrial Emissions Directive, Extractive Waste Directive, Waste Directive, Water Framework Directive and daughter directives and the Liability Directive. Soil monitoring and Resilience Directive sets a monitoring obligation that is relevant for diffuse contamination. Soil directive sets obligation to Member States to monitor the state of the soil uniformly throughout the EU, for example soil pollution (concentrations of heavy metals and organic pollutants that MS has selected). MS should also set non-binding target values and threshold values for these substances. State of soil should be assessed by comparing soil concentration to these values. Soil is in good condition if soil concentrations does not exceed non-binding target values. As stated by the SML, the comparison should be made in light of natural and anthropogenic background levels. Soil that exceeds target values can still be considered in good condition if exceedance is caused by natural background levels. ISLANDR D1.2 algorithm is useful in this context.

More information at: ISLANDR D6.1 Report on the policy framework [Link]

The ISLANDR D1.2 algorithm is available as a binary R package [iisdia_1.0.zip]

Building block

List of data gaps

There are still many data gaps in the identification of diffuse soil contamination in Europe. For example, there is need for more data on distribution of emerging contaminants such as PFAS and microplastics in our environment, and not all known contaminants are included in the national monitoring programs. Data gaps also included the lack of regular monitoring practice, and instead many countries have a single background concentration survey completed. These may not be able to describe the recent changes in the topsoil, in which case filling in the gaps should be considered depending on the case.

D1.1 Data summary - Overview of Soil Pollution in Europe [Link]

2. Vision / Initiative

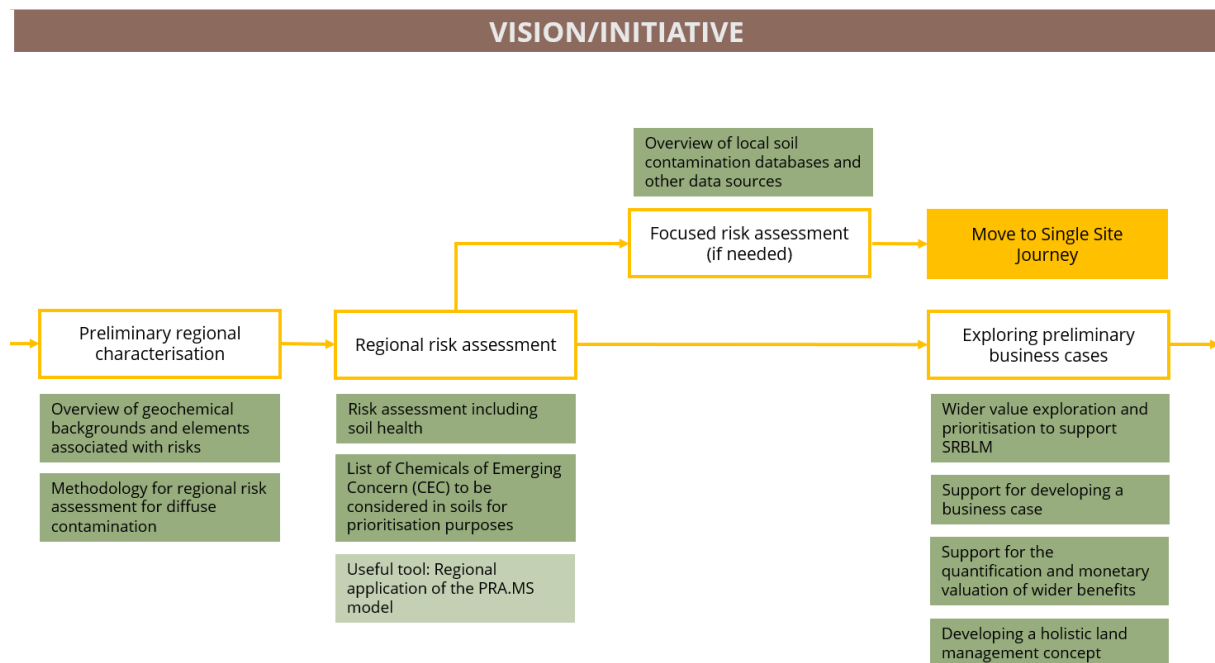
During the vision phase the site is characterised and first steps towards land use change are taken. In this phase, a landowner, regional planner, environmental authority or other actor typically related to regional land use or land use planning has an idea that the area could be used for a particular purpose. The region is characterised based on available information or new data is produced if gaps are detected.

The expected areal condition to suit the planned activity is defined and necessary regional risk assessments are conducted. These include considering the soil health aspect in land use, chemicals of emerging concern for which there may be inadequate data available, and different models and tools for regional risk assessment.

If specific problematic areas or hot spots are detected, they are dealt using focused risk assessment as in single site journey when necessary.

After the region is characterised and the specific problematic areas are known and risk assessments conducted, the preliminary land use case is devised. Considering the regional soil and diffuse contamination qualities, a holistic land management concept is

made, wider values are analysed and possible business cases are developed. Finally, the wider benefits and their monetary values are quantified.



2.1. Preliminary regional characterisation

This phase includes collection of basic background data from the region, planning based on values and needs for the region, and definition of background concentrations of potentially harmful elements and substances. A regional risk assessment is conducted using existing tools and methods to identify the problematic areas within the region and its overall suitability for different land uses.

Building block

Overview of geochemical backgrounds and elements associated with risk

EU-wide, national and regional databases were collected for diffuse soil contamination. Diffuse soil contamination databases are rare and the review on the European diffuse soil contamination databases also included geochemical mapping and monitoring databases. ISLANDR provides a metadata catalogue of these local and diffuse soil contamination databases in Europe. Data on geochemical background is needed to distinguish an area with diffuse contamination from high background concentration levels.

ISLANDR provides an algorithm for the recognition of potentially contaminated anomalous hot spots. Once these hot spots have been removed from the dataset, a map of diffuse pollution can be produced, which is a simple and a very effective form of filtering. The interpolator used in anomaly detection and for diffuse mapping can work with scattered, uncertain data and clusters that are commonly encountered in our databases and test areas. This is a new way to find diffuse soil contamination anomalies and potentially contaminated single sites.

Please find more information on databases on local and diffuse soil contamination from the ISLANDR D1.1 Data summary - Overview of Soil Pollution in Europe [Link]

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The ISLANDR Metadata Catalogue is available from [\[Link\]](#)

Building block

Methodology for regional risk assessment for diffuse contamination

ISLANDR offers an approach to assess diffuse contamination that uses measured concentrations to identify areas where widespread pollution may pose risks to health and the environment. The methodology focuses on diffuse soil contamination, which arises from widespread anthropogenic emissions rather than from discrete point sources. This assessment requires quantitative input data, and in ISLANDR it is supported by regional datasets and probabilistic interpolation models developed to handle sparse, imprecise, and clustered data (IISDIA algorithm) and by the developed regional risk assessment method. By integrating exposure pathways with receptor sensitivity, the methodology produces a relative ranking of areas affected by diffuse contamination, highlighting those that may pose risks to human health or the environment. These results can inform land-use planning, support regulatory development, and indicate priority areas for monitoring or, if needed, site-specific follow-up.

IISDIA algorithm is available in: [\[link\]](#)

Regional risk assessment method is described in D2.2. Large scale risk assessment methodology and application to selected areas [\[link\]](#) and the tool is available in: [\[link\]](#)

2.2. Regional risk assessment

In this phase ISLANDR suggests using the impacts of contamination on soil health and functionality as a receptor in regional risk assessment and management. ISLANDR project has produced tools for integrating soil health into soil risk assessment and remediation in different steps of the process. This is supported by a watchlist for chemical of emerging concern and has produced two major deliverables: a prioritised list of the CECs identified as the most concerning for soils, and a complementary list of substances for which current knowledge is insufficient to allow for a reliable assessment. In addition to this approach there are additional tools available: PRA.MS model for regional risk assessment.

Building block

Risk assessment including soil health

Extension of risk of land-based management to soil functionality > Provides a decision tree with soil health descriptors according to land use.

ISLANDR suggests using the impacts of contamination on soil health and functionality as a receptor in risk assessment and management. It has produced four major outputs: (1) a review paper analysing pesticide contamination trends across Europe and identifying regional contamination patterns and relevant pesticides and metabolites to watch; (2) a color-coded matrix evaluating soil health descriptors relevant to different land uses; (3) a matrix evaluating the impact of conventional and low-impact remediation techniques on soil functions (literature review); and (4) a gamified approach design to gather different stakeholders' perspectives on soil health descriptors. This contributes to the development of a decision tree that integrates contamination, land use-specific soil health descriptors, and the impact of LIRT techniques on soil functionality to integrate soil health into contaminated land management.

More information at: [\[link\]](#)

Building block

List of Chemicals of Emerging Concern (CEC) to be considered in soils for prioritisation purposes

The method developed as part of the ISLANDR project proposes a multi-criterion, risk-based prioritisation framework for soil contaminants of emerging concern (CECs) at national and EU scales, structured around the Source–Pathway–Receptor (SPR) model. This method has produced two major deliverables: a prioritised list of the CECs identified as the most concerning for soils, and a complementary list of substances for which current knowledge is insufficient to allow for a reliable assessment. These results were obtained using a dedicated Excel tool, regularly updated, that incorporates both risk scores and confidence indicators. This dual approach not only

allows substances to be targeted for priority monitoring but also guides research efforts towards critical data gaps at the European scale. The excel tool and the CECs lists will be freely available online on the ISLANDR website.

More information at: [\[link\]](#)

Useful tool

Regional application of the PRA.MS model

One example of application of the PRA.MS model in regional risk assessment was given by Minolfi et. Al. 2018. A regional approach to the environmental risk assessment – Human health risk assessment case study in the Campania region. Journal of Geochemical Exploration 184, 400-416.

<http://dx.doi.org/10.1016/j.gexplo.2016.12.010>

2.3. Focused risk assessment (if needed)

If a local hot spot, even a large one, is identified at this stage, see journey for a single site. There are publicly available databases on local soil contamination, that can be used as background information for local contamination.

Building block

Overview of local soil contamination databases and other data sources

Overview of local soil contamination databases and other data sources > Support planning and implementing registers/databases suggested in the soil monitoring directive

In many states, national and regional authorities have already systematically and actively identified all sites where soil contamination is suspected based on evidence collected through all available means. According to the questionnaire sent to national experts, some countries utilise local soil contamination databases in prioritisation of investigation- and remediation actions of contaminated sites. The web search showed that the site data in many databases contains information of priority classification. National and regional databases feed to European-wide indicators used to assess status of local soil contamination and potentially later to national soil contamination registers as required in Soil Monitoring Law. ISLANDR provides a metadata catalogue of these local (and diffuse) soil contamination databases in Europe.

More information at: ISLANDR D1.1 Data summary - Overview of Soil Pollution in Europe (Table 7. Summary of the results of local soil contamination database search) [\[Link\]](#)

The ISLANDR Metadata Catalogue is available from [\[Link\]](#)

➔ **Move to Single site Journey**

2.4. Exploring preliminary business cases

This phase includes recognition of possible land uses, estimated costs and benefits including wider values to society, recognition of possible financial models suitable for the area in question, financial and economic viability assessment and exploration of partnerships. Significant cost savings can be achieved with good planning at this stage. During the development of the preliminary business case, roadmap users explore future land uses, how these might deliver value and how they relate to the original interest in the site; a timeline for the remediation and responsible party; and the financial and economic viability of the remediation project. This activity also includes the exploration of possible financial models and partnerships, which will inform the exploration of strategies later on. This involves an iterative process for exploring socio-economic impacts and preliminary business cases through the identification of:

- Alternative land remediation and re-use scenarios

- Wider values – including prioritisation of benefits for different groups of stakeholders and possible value creation for investors
- Linking the project-relevant costs and benefits to specific beneficiaries or payers to identify possible investors for the project and develop the business case
- Relevant timelines for different scenarios.

ISLANDR provides building blocks Wider value exploration and prioritisation to support SRBLM, Support for developing a business case, Support for the quantification and monetary valuation of wider benefits and block Developing a holistic land management concept, to support this activity.

Building block Wider value exploration and prioritisation to support SRBLM
<p>ISLANDR provides support for envisioning, identifying and prioritising wider values for alternative land use and remediation scenarios in collaboration with relevant stakeholders using a serious game approach, based on a checklist of wider values, indicators and a vision creation exercise. The purpose is to make decision-makers and investors aware that there are wider values other than strictly financial that may be very important for a decision about how to sustainably remediate and redevelop a site and improve the value proposition, particularly where the direct financial case is marginal or even negative.</p> <p>More information at: ISLANDR D3.2 [link] and ISLANDR D4.2 [link]</p>
Building block Support for developing a business case
<p>Provides support for developing a business case accounting for wider values and evaluating the potential costs and benefits relating to the site remediation and reuse strategies. The purpose is to provide a framework which supports a local project economic analysis to evaluate the 1) potential financial return on investment, 2) potential social return on investment, and 3) opportunities for internalization of wider values as alternative sources of revenue or reduced costs to improve the value proposition for such projects and identification of different financial mechanisms to develop a blended finance strategy.</p> <p>More information at: ISLANDR D4.2 [link]</p>
Building block Support for the quantification and monetary valuation of wider benefits
<p>Provides practical and methodological support for the quantification and monetary valuation of wider benefits (economic values) by 1) providing a searchable database containing economic valuation studies and economic values, some of which are suitable for value transfer, and 2) a compilation of economic valuation methods that have been applied in various studies in the brownfield remediation and redevelopment context.</p> <p>More information at: ISLANDR D4.1 [link] and ISLANDR D4.2 [link]</p>
Building block Developing a holistic land management concept
<p>The international consensus that has emerged over the past 20-30 years is that decisions regarding contaminated sites should be made based on understanding and managing risks to human health and the wider environment, taking into account the current or planned use of the land. More recently, there has been a growing emphasis that risk management should also align with sustainable development principles. This integrated approach is known as sustainable and risk-based land management (SRBLM), and is increasingly recognized in international practice, policy, and regulation. Risk management of contaminated sites depends on knowledge of the linkages between sources, pathways and receptors, an estimation of their seriousness and the development of strategies to break linkages that lead to unacceptable risks. The sustainability of risk management can be considered at multiple stages, including how best to manage the design and planning of any change in site use, and/or the choices made between different risk management (i.e. remediation) techniques.</p> <p>Diffuse contaminated sites may exist in a long-term state of under-utilisation and degradation, because there is an insufficient economic case for land restoration. Combining the deployment of low input remediation techniques with a wider perspective of beneficial re-use of land (e.g. for biofeedstock production, biodiversity, public amenity etc) may leverage opportunities for economically favourable diffuse land contamination.</p>

ISLANDR D3.2 provides overarching guidance on the state of practice for achieving sustainable and risk-based land management and highlights how this can be enhanced by consideration of (a) use of low input remediation techniques; (b) circularity – i.e. linkage to a circular economy, (c) maximising the value of restoration to improve its economic case; (d) proper consideration of soil health.

More information at: [\[link\]](#)

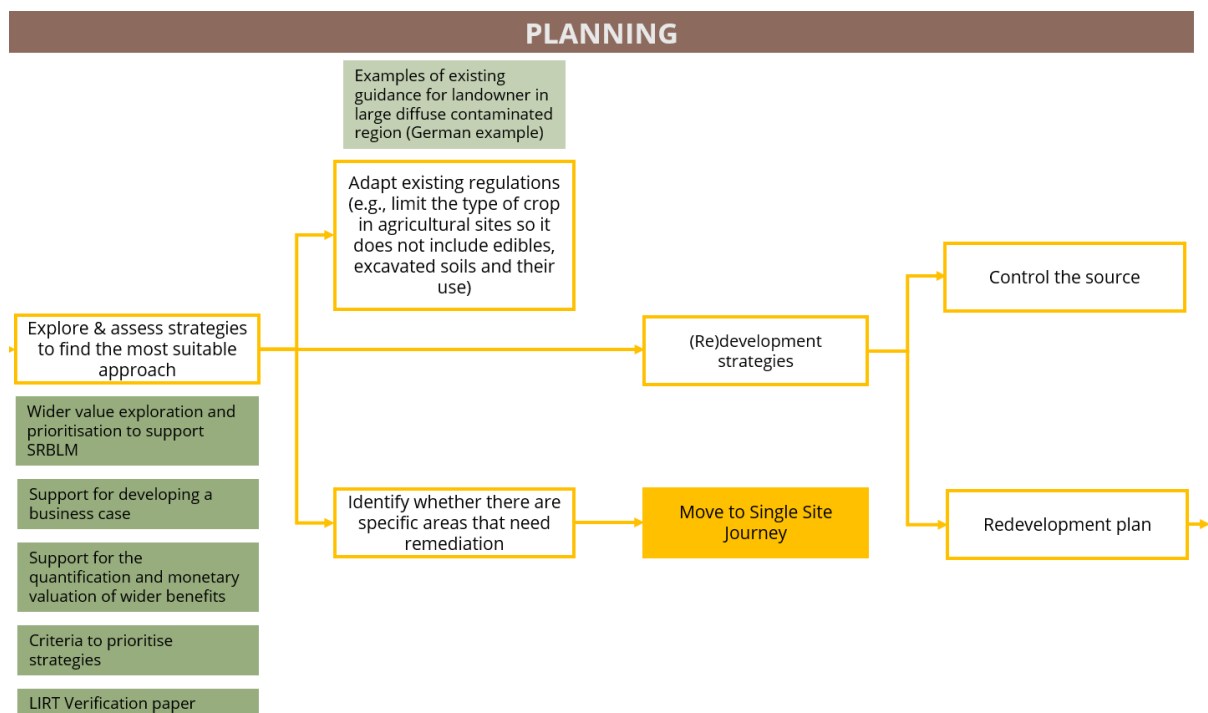
Circular economy assessment tool > Compare remediation strategies ex ante (planning stage) to see how far they contribute to circular economy

Upcoming papers on low input remediation techniques

3.Planning

This wrap-around phase can include multiple activities and is the process by which the vision is elaborated to finally arrive at detailed action plans. In the planning phase the strategies for redevelopment are explored and assessed to find the most suitable for the region. This includes considering wider values created in the process or already existing in the region, support for developing the business case, quantification and monetary valuation of wider benefits as well as support in the form of prioritising the strategies. Existing regulations are adapted to the regional context. Examples from other areas with similar issues may provide ideas on how the diffuse contamination can be managed. If some areas within the region are identified with the need for remediation, they can be handled according to the single site journey.

When redevelopment strategies are selected for the region, the planning proceeds towards either controlling the source of contamination in the region for areas where land use will not change, or to redevelopment plan for the areas where land use will undergo changes.



3.1. Explore and assess strategies to find the most suitable approach

In this phase the detailed planning is done from the wider values and financial restrictions point of view. Sustainable risk-based land management (SRBLM) is supported by providing guidance, as well as the development of a business case. As a part of forming the strategy for the wider benefits, such as creating recreational areas, or improving biodiversity or soil health, estimated monetary values are provided. Finally, the exploration ends by selecting criteria to prioritise the remediation and management strategies.

Building block Wider value exploration and prioritisation to support SRBLM
<p>ISLANDR provides support for the envisioning, identifying and prioritising wider values for alternative land use and remediation scenarios in collaboration with relevant stakeholders using a serious game approach, based on a checklist of wider values, indicators and a vision creation exercise. The purpose is to make decision-makers and investors aware that there are wider values other than strictly financial that may be very important for a decision about how to sustainably remediate and redevelop a site and improve the value proposition, particularly where the direct financial case is marginal or even negative.</p> <p>More information at: ISLANDR D3.2 [link] and ISLANDR D4.2 [link]</p>
Building block Support for developing a business case
<p>Provides support for developing a business case accounting for wider values and evaluating the potential costs and benefits relating to the site remediation and reuse strategies. The purpose is to provide a framework which supports a local project economic analysis to evaluate the 1) potential financial return on investment, 2) potential social return on investment, and 3) opportunities for internalization of wider values as alternative sources of revenue or reduced costs to improve the value proposition for such projects and identification of different financial mechanisms to develop a blended finance strategy.</p> <p>More information at: ISLANDR D4.2 [link]</p>
Building block Support for the quantification and monetary valuation of wider benefits
<p>Provides practical and methodological support for the quantification and monetary valuation of wider benefits (economic values) by 1) providing a searchable database containing economic valuation studies and economic values, some of which are suitable for value transfer, and 2) a compilation of economic valuation methods that have been applied in various studies in the brownfield remediation and redevelopment context.</p> <p>More information at: ISLANDR D4.1 [link] and ISLANDR D4.2 [link]</p>
Building block Criteria to prioritise strategies
<p>Excel-based tool to conduct a quick analysis to rank potential strategies based on environmental, human, social, economic and technical aspects. Stakeholders involved in remediation and redevelopment can utilise the tool to quickly screen the performance of different strategies against the set criteria and adjust the weights according to priorities.</p> <p>More information at: [link]</p>
Building block LIRT Verification paper
<p>Particularly at TRL8 or 9 there may be good reasons to verify LIRT claims for low resource and energy intensity, use of renewables and delivery of wider benefits. This verification can then support future deployments of the LIRT, and document evidence that low resource and energy intensity, use of renewables and delivery of wider benefits have been achieved. ISLANDR provides a position paper on LIRT verification which is relevant at the PLANNING stage (verification planning), REALISATION stage (data collection) and MAINTENANCE Stage (reporting and ongoing monitoring, especially for long term land management solutions).</p>

Building block link: Annex 2 of D3.2

3.2. Adapt existing regulations

If the contaminated region is considerable in size, a direct remediation of soil may not be suitable due to significant costs or to size / area / volume of the required remediation. These types of regions may be managed by including specific regulations for the region in national or regional land use plans. If the local legislation does not allow this, one option, although very slow and uncertain, can be to adapt local regulation regarding that specific region. One example of creating specific land use regulation for a diffuse soil contamination region is given below.

ADDITIONAL Building block

Examples of existing guidance for landowner in large diffuse contaminated region (German example)

Regarding soil contamination the German legislation (BBodSchG (1998) – Federal Soil Protection Act - Act on Protection against Harmful Changes to Soil and on Rehabilitation of Contaminated Sites) in general concentrates on site specific procedures for assessment and remediation as well as for managing the re-use of excavated soil material. It established the opportunity for the federal states (Bundesländer) to lay down regulations to indicate large areas of contaminated soil and specific measures to manage these areas (§ 21 (3) BBodSchG).

Many of the federal states took this opportunity and laid down general regulations on how to indicate and how to install specific decrees on such an area. So did Saxony in 2004 within the Saxon Waste Management and Soil Protection Act (§ 9 SächsABG – updated as § 14 SächsKrWBoschG 2019) empowering the regional State Directorate (Landesdirektion) to establish specific Soil Planning Areas to manage large area contamination, perform assessment and set up measures. The Saxon State Office for Environment and Geology together with the State Directorate started a regional soil contamination survey was to outline these areas – starting with the region of Freiberg, affected by more than 600 years of mining, ore processing and smelting.

Several steps have been established in Saxony:

- Extensive soil investigation and analysis of regional contamination (As, Pb, Cd)
- Geostatistical data processing
- Categorization and soil contamination mapping on As, Pb and Cd concentration
- Generalize from single elements and establish zones of similar contamination level (to manage re-use of excavated soil)
- Prepare a regional risk assessment for direct contact and ingestion of contaminated soil and transfer to food and fodder plants (groundwater was excluded as not affected on a regional level) using the most relevant exposure scenarios: playgrounds, housing areas, parks and leisure areas regarding direct contact and arable land and grassland for agricultural land use.
- Regarding direct contact with soil, oral ingestion by children, especially toddlers, were identified to be most relevant. Therefore, a standard stomach-colon-ingestion lab model was used and several hundreds of soil samples were analysed according to DIN 19738 to get regional data on contaminant bioavailability after soil ingestion.
- A statistical probability model was built using the regional data range on bioavailability to mark contaminant concentrations in soil that will exceed the defined risk level at a specified likelihood.
- A probability of less than 5 % was accepted to label these zones to cause no harm and at these levels no measures have been addressed. From 5 to 50 % harm could not be fully excluded and a set of moderate measures are addressed (together with an option that soil analysis could prove that there is no need to take measures). From 50 to 95 % harm was labelled very likely and a set of strong measures are addressed (together with an option that soil analysis could prove that moderate measures will suffice). For the highly contaminated zones above 95 % strong remediation measures have to be applied, and a counterevidence requires a full expert assessment. A regional map (scale 1:10000) was built for the main exposure scenarios.
- Regarding soil to plant transfer the federal regulation was used (arable land and grassland) together with data from an extended field survey on contaminant transfer into the main crops on arable land, especially for wheat. A regional map (scale 1:10000) was built to help farmers and gardeners to identify plots with elevated risk

of transfer to plants. Recommendation was addressed using several measures to meet the EU-regulation on contaminants in food, mainly asking for pre-harvest analysis to direct the crops to be used for food, fodder or bioenergy.

- All maps and the regulatory text was set into force by a regional ordinance for the region of Freiberg in 2011. In 2025 in Saxony for the second region Annaberg such an ordinance was laid down following the same procedure like for Freiberg. Recommendation for farmers and local gardening was published.

All these ordinances, guidance and recommendations address landowners, as well as all who are affected by contaminated soil, regardless of whether owner or renter, doing construction work, landscape architecture, agriculture etc.

An overview on how large contaminated areas are managed in the region of Freiberg (Saxony) in Germany can be found in: <https://doi.org/10.1016/j.jhazmat.2021.127677> or <https://doi.org/10.1016/j.jhazmat.2024.136962>.

3.3. Identify whether there are specific areas that need remediation

If a local hot spot, even a large one, is identified in this stage, see journey for a single site. There are publicly available databases on local soil contamination, that can be used as background information. These are described in more detail in D1.1 Data summary - Overview of Soil Pollution in Europe and made available in ISLANDR Metadata Catalogue. [link]

➔ **Move to Single site Journey**

3.4. (Re)development strategies

ISLANDR does not provide specific guidance on how to prepare a redevelopment strategy, and how different aspects should be weighted. From the soil health point of view, and in order to save in development costs, SRBLM approach may be the most sustainable on a long term. This step mainly concerns regional planning.

3.5. Control the source

ISLANDR does not provide specific technical guidance on how to control a contaminant source. Legislation on expectations and obligations for contaminated soil remediation as well as requirements for users of contaminating substances exist on a national level.

3.6. Redevelopment plan

This stage introduces strategies for area redevelopment through e.g. modifying land uses and promoting stakeholder participation in the process. This step concerns more detailed planning within the regional plan.

ISLANDR does not provide specific guidance on making redevelopment plans. The redevelopment plan can include basically any land use type. It should be noted, that if the soil with diffuse contamination is identified with different levels of contamination, cost savings may be achieved by considering the soil suitability for the intended new land use. Some combinations of contamination and land use may incur notable remediation costs, whereas using sustainable risk-based land management methods (SRBLM) approach, considering wider values and soil health in the process may lower the development costs. Redevelopment should be fitted to local needs and ideas according to national legislation.

4. Realisation

During the realisation phase, land use of the area continues as either actively remediated to suitable land uses or living with the passively managed or reduced risk to human health and to the environment.

REALISATION



4.1. Living with diffuse contamination with reduced risk

Living with diffuse contamination with reduced risk is achieved through controlling the source of contamination by technical means or through redevelopment plan for the area. Very large areas can be controlled by designated guidelines or local regulations and orders in the land use plan. Approaches that can be typically considered for diffuse soil contamination areas in this phase are Gentle Remediation Options (GRO), Low Input Remediation Techniques (LIRT) and Sustainable Risk-Based Land Management (SRBLM).

Building block LIRT Verification paper

Particularly at TRL8 or 9 there may be good reasons to verify LIRT claims for low resource and energy intensity, use of renewables and delivery of wider benefits. This verification can then support future deployments of the LIRT, and document evidence that low resource and energy intensity, use of renewables and delivery of wider benefits have been achieved. ISLANDR provides a position paper on LIRT verification which is relevant at the PLANNING stage (verification planning), REALISATION stage (data collection) and MAINTENANCE Stage (reporting and ongoing monitoring, especially for long term land management solutions).

Building block link: Annex 2 of D3.2

5. Maintenance

The scope of maintenance depends on the site context. In some cases, where risk management has been completed, the primary maintenance activity might be institutional control, where the record of site use and risk management is maintained by a planning authority. There will be ongoing monitoring and verification tasks for longer-term treatments, such as natural attenuation, containment, and phytoremediation. For combined re-use and remediation, there may be a variety of business, sustainability information and monitoring collected, for example, related to site re-use.

This phase also encompasses stewardship activities, for example, related to the gradual improvement of soil health.

MAINTENANCE

Monitoring

LIRT Verification paper

5.1. Monitoring

Monitoring is an essential part of maintaining soil health in the future. This is required from all member States in the EU by the Directive on Soil Monitoring and Resilience. Monitoring validates the result of remedial activities or other chosen control mechanism for the area in question ensuring soil is in good condition regarding impacts to human health and the environment. This phase may include monitoring of previously chosen methods (Gentle Remediation Options (GRO), Low Input Remediation Techniques (LIRT) and Sustainable Risk-Based Land Management (SRBLM)).

Building block LIRT Verification paper

Particularly at TRL8 or 9 there may be good reasons to verify LIRT claims for low resource and energy intensity, use of renewables and delivery of wider benefits. This verification can then support future deployments of the LIRT, and document evidence that low resource and energy intensity, use of renewables and delivery of wider benefits have been achieved. ISLANDR provides a position paper on LIRT verification which is relevant at the PLANNING stage (verification planning), REALISATION stage (data collection) and MAINTENANCE Stage (reporting and ongoing monitoring, especially for long term land management solutions).

Building block link: Annex 2 of D3.2