



# RAWFILL WP T1

## Enhanced Inventory Framework

### Deliverable 4.1

## List of Enhanced Landfill Inventory Framework Indicators

May 2020



**Interreg North – West Europe (NWE) VB 2014 - 2020**

**Project:** NWE377 RAWFILL

**Title:** Supporting a new circular economy for RAW materials recovered from landFILLS

Table

ACRONYMS AND DEFINITIONS .....	3
PRESENTATION OF RAWFILL .....	5
LANDFILL MINING PERSPECTIVES .....	6
ELIF STRUCTURE AND RELEVANT FIELDS .....	8
Partners involved .....	8
ELIF description .....	9
Data accuracy .....	11
Data source .....	11
Generic information.....	11
Regulatory information .....	11
Landfill ID card .....	12
Surroundings .....	16
Landfill geometry .....	18
Landfill Waste Materials.....	19
Contact.....	23

## ACRONYMS AND DEFINITIONS

**COCOON:** “Consortium for a Coherent European Landfill Management Strategy”, an INTERREG Europe-funded project, whose objective is to develop, integrate and improve relevant policy instruments, while increasing subsidies through operational programs for landfill mining projects,  
<https://www.interregeurope.eu/cocoon/>

**DST:** “Decision Support Tool”, a tool that will rank landfills regarding landfill mining opportunities. The ranking is based on information following ELIF structure. It will operate at 2 levels: “Selection” (a first level of quick screening to identify landfills with a priori interesting potential but which need further historical investigations and geophysical survey) and “Ranking” (a prioritization tool to rank pre-selected and fully investigated landfills of economic interest for raw material recovery purposes).

**ELFM:** “Enhanced Landfill Mining”, the safe exploration, conditioning, excavation and integrated valorisation of (historic, present and/or future) landfilled waste streams as both materials (Waste-to-Material, WtM) and energy (Waste-to-Energy, WtE), using innovative transformation technologies and respecting the most stringent social and ecological criteria).

**ELIF :** “Enhanced Landfill Inventory Framework”, a landfill inventory structure that is focused on information regarding resources that can be extracted from a landfill (materials, energy carriers and land). The ELIF is used to describe landfills not only in terms of environmental and risk issues, but focuses on the quality and the quantity of dormant materials lying on them, in order to supply relevant data for stakeholders involved in ELFM projects.

**LFM:** “Landfill Mining”, the safe exploration, conditioning, excavation and integrated valorisation of (historic, present and/or future) landfilled waste streams as both materials (Waste-to-Material, W2M) and energy (Waste-to-Energy, W2E), without specification of technologies.

**RAWFILL:** “Supporting a new circular economy for RAW materials recovered from landFILLs”, an INTERREG North-West Europe-funded landfill mining project, launched in March 2017, [www.nweurope.eu/rawfill](http://www.nweurope.eu/rawfill)

**RECLAIM:** “Landfill mining pilot application for recovery of invaluable metals, materials, land and energy”, project funded by the European Commission through Life+ 2012 vehicle, contract LIFE12 ENV/GR/000427

**SMART GROUND:** “SMART data collection and inteGration platform to enhance availability and accessibility of data and information in the eU territory on secondary raw materials”, an H2020-funded project aiming at improving the availability and accessibility of data and information on SRM (Secondary Raw Materials) in the EU

territory, while creating collaborations and synergies among the different stakeholders involved in the SRM value chain, [www.smart-ground.eu](http://www.smart-ground.eu)

**UXO:** unexploded ordnance (grenades, bombs, etc.) coming from warfare, military exercises and dumping of ammunitions, that can be found in some landfills or below the ground level.

## PRESENTATION OF RAWFILL

RAWFILL (“Supporting a new circular economy for RAW materials recovered from landfills”) is an INTERREG EU-funded landfill mining project, gathering partners and associated partners of North-West Europe regions and supported by EURELCO. RAWFILL was launched in March 2017 and will end in March 2021.

The ultimate goal of RAWFILL is to allow North West Europe public & private landfills owners & managers to implement profitable resource-recovery driven landfill mining and enhanced landfill mining projects, hereunder named LFM or ELFM according to the context.

RAWFILL develops a cost-effective standard framework for creating landfill inventories (ELIF) based on existing experiences, an innovative landfill characterization methodology by geophysical imaging and guided sampling and an associated Decision Support Tool (DST) to allow smart ELFM project prioritization. The whole concept was demonstrated in eight pilot sites in Flanders (Meerhout), Wallonia (Onoz, Bertrix), Germany (Leppe), UK (Emersons green and Stockley Park) and France (Les Champs Jouault).

More information about RAWFILL and its progress reports can be found at the project site: [www.nweurope.eu/rawfill](http://www.nweurope.eu/rawfill)

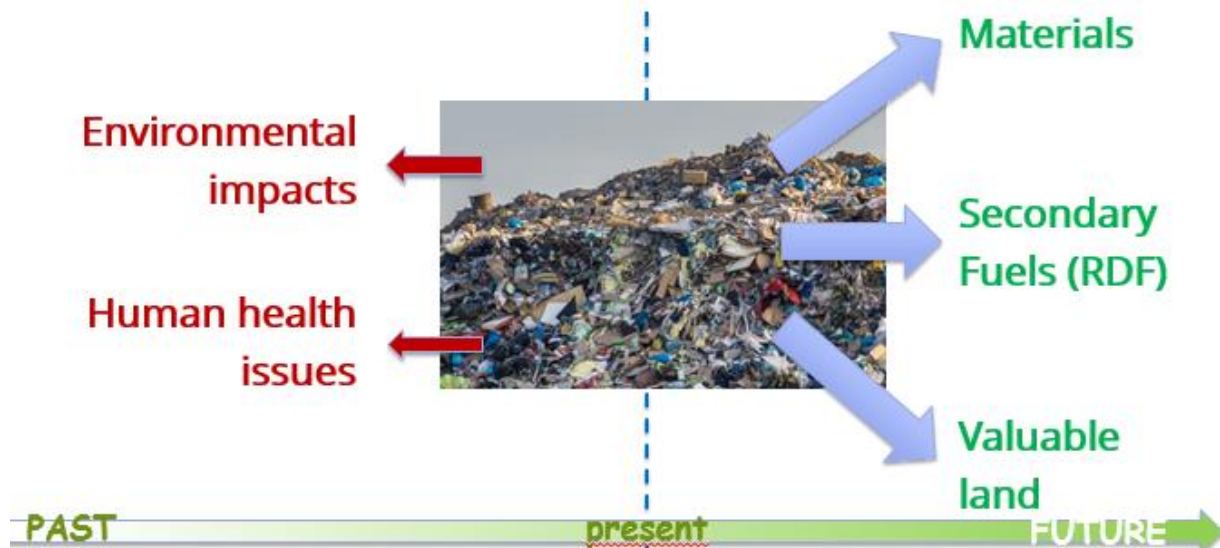
The ELIF will be used to describe landfills not only in terms of environmental and risk issues, but will focus on the quality and the quantity of dormant materials lying on them, in order to supply relevant data for stakeholders involved in ELFM projects.

The ELIF is the basis for the DST ranking tool and so a prerequisite to assess feasibility, business plan & business cases for launching profitable projects.

The DST is a ranking tool that allow ELFM projects prioritization based on a set of suitable physical, chemical, environmental, technical and social information. It integrates the multiple aspects involved in ELFM projects, i.e. economic, technical, environmental & social factors in order to compare and classify landfills regarding their ELFM interest.

## LANDFILL MINING PERSPECTIVES

The figure hereunder illustrates the change of paradigm regarding landfills that emerges now in many parts of the world. Landfills are not more seen as final deposits that will remain indefinitely and become integrated parts of the landscape, generating negative (sometimes positive<sup>1</sup>) environmental impacts and negative health issues.



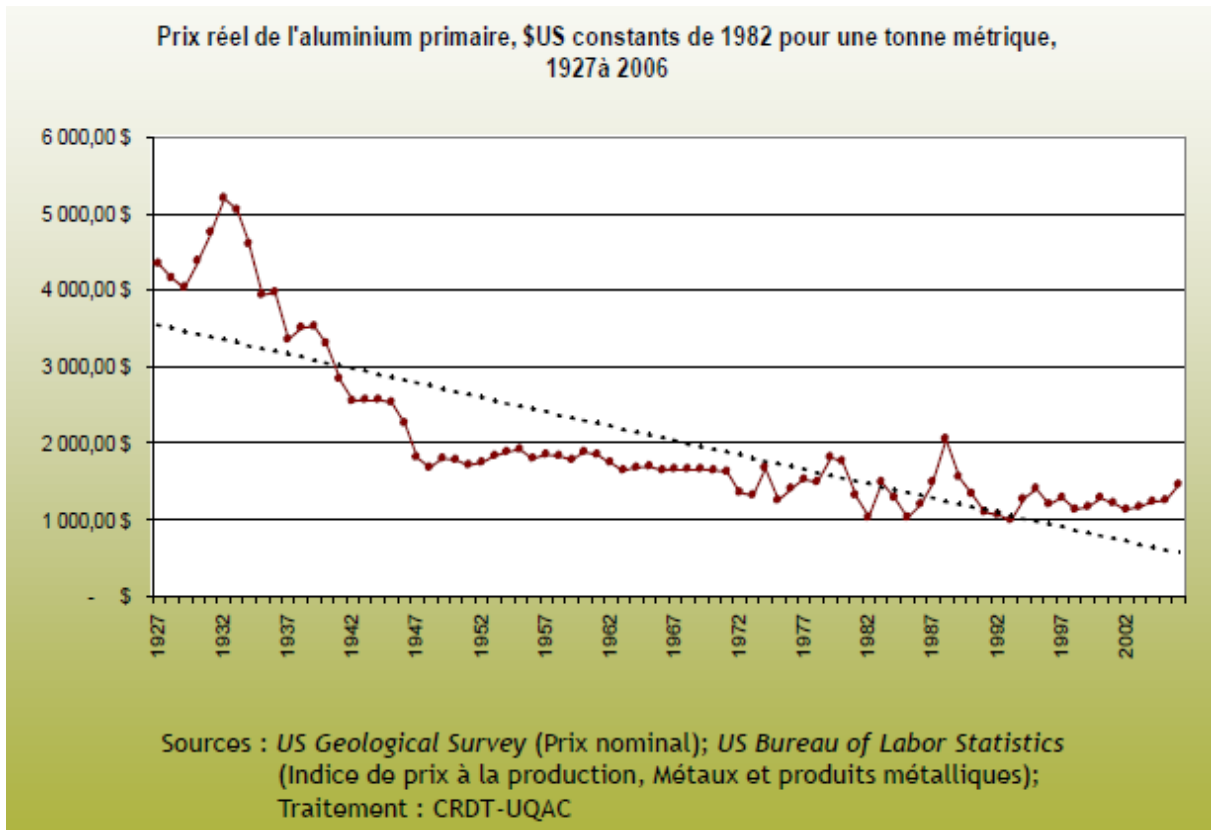
Landfills are seen as deposits of dormant anthropogenic resources or reserves as materials, secondary fuels and valuable land.

The difference between resources and reserves is very important in the RAWFILL approach: resources are reasonable prospects for eventual economic extraction in the foreseeable future while reserves are resources with current economic extraction possible, without specifying any timeline.

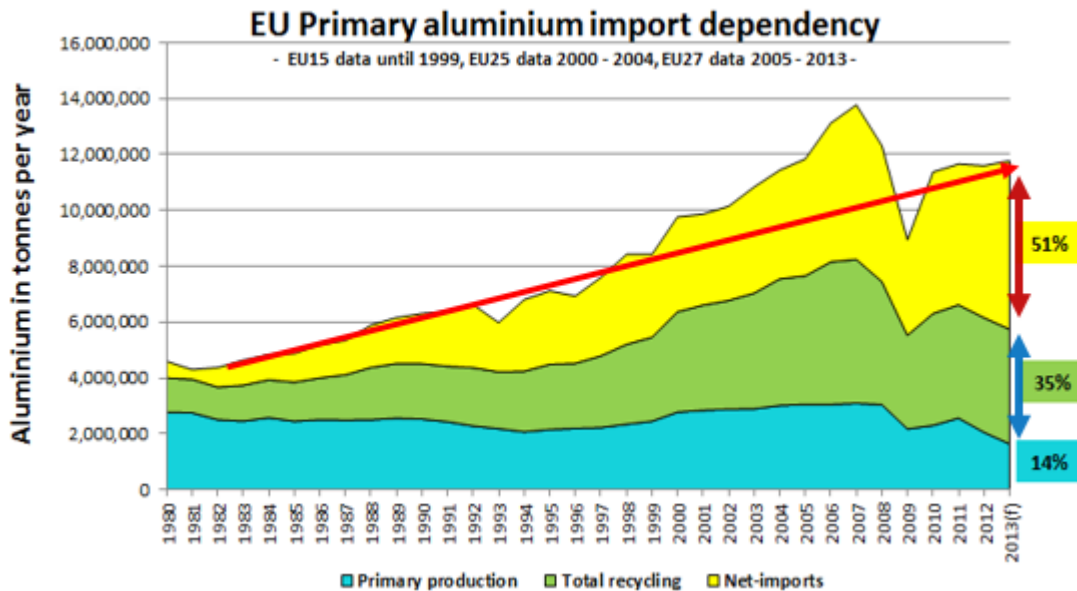
In any case, a deep knowledge of what lies in the landfill remains important, even if we are quite sure that some landfills will not be short term treated. That's why the RAWFILL ELIF has to be developed now and completed in the next years, even if the market is only emerging.

Regarding resource consumption, we will just develop one example, but many others can be found. The production price of a common important metal as Aluminium reaches a stable level as shown hereunder:

<sup>1</sup> Parts of the territory, generating no significant contamination, that can be given back to nature after a full or light rehabilitation, or no rehabilitation at all, sheltering specific fauna and flora, walking areas, etc.



But the consumption increases constantly:



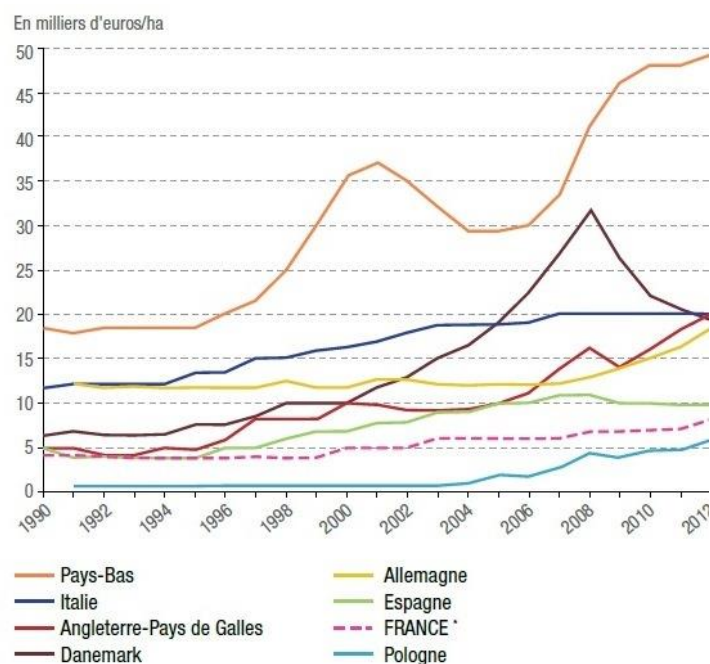
The primary Aluminium production within EU is quite stable. One third comes from recycling, with a stabilized level and 51% come from imports, this last part still increasing because of low prices from foreign suppliers.



Should the import sources become less available or more expensive for any geopolitical reasons, there will be a serious gap to overcome. Increasing primary production from bauxite is difficult and expensive, absorbing huge quantity of electricity and leading to mining environmental problems. Increasing recycling is an option if alternative sources of metals can be found. Precisely, landfills contain a large part of the metal produced in the past.

So, evaluating reserves lying in landfill may be of strategic importance.

Last but not least, reclaiming land within NWE is also a matter of great concerns in some regions.



\* Terres, prés et vignes réunis.

Figure – Evolution of the prices of agriculture parcels between 1990 and 2012.

Source: ©Safter

Then, an emergence of ELFM market will lead to improved technologies for digging, sorting and treating the waste so that the profitability of a landfill mining operation will increase by reducing operation costs.

Last but not least, adapted ELFM oriented legislations should be developed in the future in order to facilitate ELFM operations.

## ELIF STRUCTURE AND RELEVANT FIELDS

### Partners involved

#### Lead Partner



- Atrasol sprl

#### Partners involved

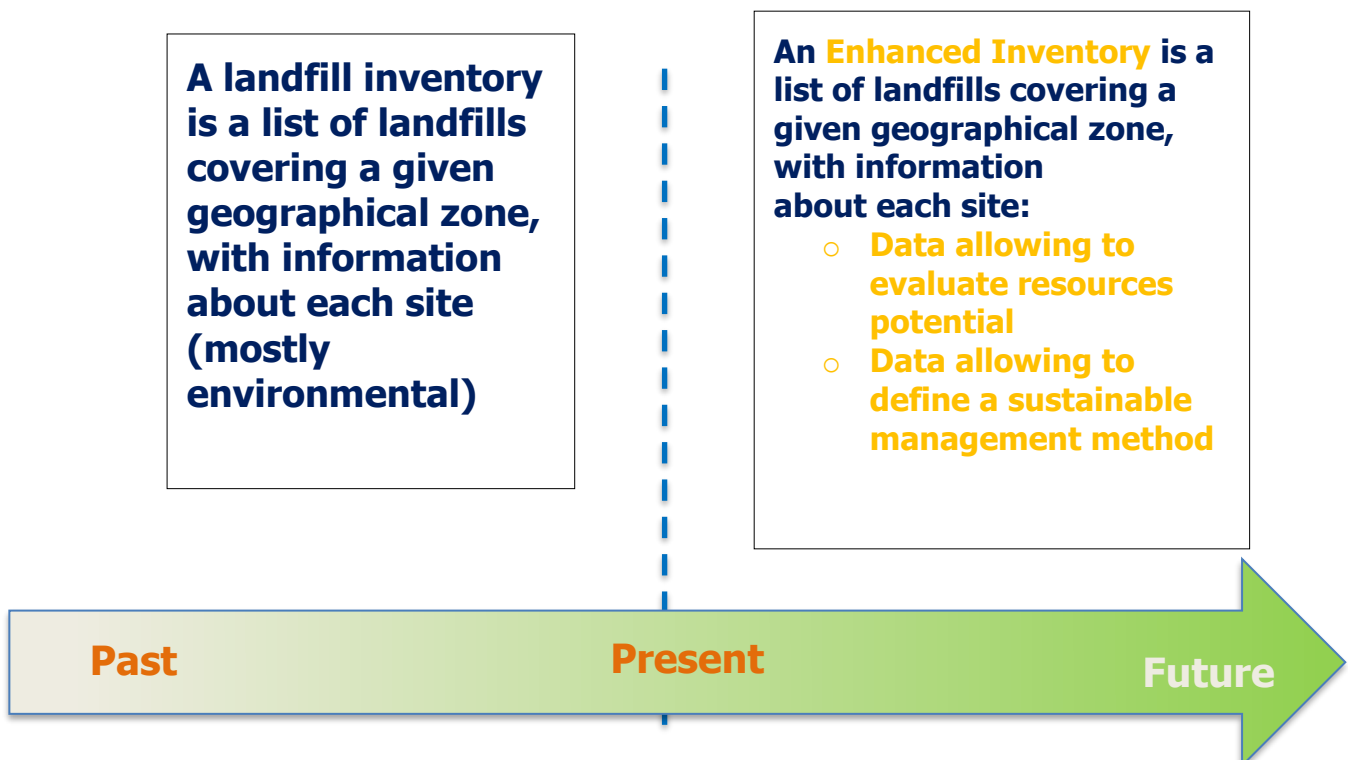
- BAV
- NERC
- SAS Les Champs Jouault
- SPAQuE
- OVAM
- ULiège

#### ELIF description

**ELIF:** “Enhanced Landfill Inventory Framework”, is a landfill inventory structure focused on information regarding resources that can be extracted from a landfill (materials, energy carriers and land).

ELIF is used to describe landfills not only in terms of environmental and risk issues, but focuses on the quality and the quantity of dormant materials lying on them, in order to supply relevant data for stakeholders involved in ELFM projects.

This approach is innovative, as no known landfill inventory among these analysed contains such ELFM-driven information.



There are finally three main drivers related to a decision to launch an ELFM project:

- An **economic driver** related to material valorisation and land reclaiming
- A **territorial strategy driver** related to the planned local/regional land development
- An **environmental driver** related to environmental and human health issues

ELIF structure takes these drivers into account, although its structure is proposed in four sections: landfill ID Card, surroundings, landfill geometry and waste.

ELIF is the basis for the DST ranking tool and so a prerequisite to assess feasibility, business plan & business cases for launching profitable projects. DST is a ranking tool that will allow ELFM projects prioritization based on a set of suitable physical, chemical, environmental, technical and social information. It will integrate the multiple aspects involved in ELFM projects, i.e. economic, technical, environmental & social factors in order to compare and classify landfills regarding their ELFM interest.

This ELIF is based on results of previous WP T1 deliverables:

- [A T.1.1](#), which analyses current situation in NWE countries by collecting structures of public & private available LFs databases/inventories.
- [A T.1.2](#), a short review of landfill mining experiences focused on the methodology applied to evaluate the landfill resources potential.

Here is the structure of ELIF:

<b>Section</b>	<b>Definition</b>	<b>Fields examples</b>
0. Generic information	Information about datasheet creation and maintenance	Date of creation, updating and who is responsible
1. Landfill ID Card	All administrative information about a given landfill	Name, location, owner, operator, monitoring, aftercare, legal status, permits
2. Surroundings	All relevant data about the landfill's surroundings	Land planning, territorial strategy, current use, specific risks, geology, groundwater, access
3. Geometry	Landfill geometry, regardless waste information	Surface, volume, depths, stability, bottom, capping, biogas network
4. Waste	Specific information about the landfill's waste streams	Types, density, water and gas content, temperature estimated composition from the site Resource Distribution Model (RDM)

Table 1 - ELIF divisions and most representative fields.

## Data accuracy

Regarding existing information, the level of accuracy of some data is sometimes difficult to estimate, for example the indicated surface of the landfill which can be mixed with the total surface of the site, the volume of waste which can be just a draft estimation based on a mean height and a given surface, the type of waste which remain generic in uncontrolled landfills, etc. As this precision is very important for launching an ELFM feasibility study, ELIF specifies for each DST-relevant field an accuracy estimation that is taken into account for the ranking (unknown, estimated, measured). To facilitate the reading, we will not precise this accuracy level indicator when describing each field in the present document.

Dates are supposed to come from relevant sources and will not be associated with an accuracy estimation.

## Data source

For some fields, it will be very important to precise the origin of the information, and specify if this information has been measured with some relative precision or simply estimated or is known as found in documents, without specifying their origin. Data measured by the responsible of the database will be considered as the most valid ones.

## Generic information

**ELIF datasheet responsible:** name and position of the person responsible for the validation of the datasheet.

- Name
- Position

**Creation date:** date of creation of the datasheet.

- Date (dd/mm/year)

**Date of updating:** date of last updating of the data sheet. "Updating" means either completion of the data sheet with missing information or modification of existing data. We assume that regular backups ensure that all previous versions of the data sheets still exist somewhere. This way allows to avoid to keep log files.

- Date (dd/mm/year)

## Regulatory information

This section gathers all local/regional/national regulatory information applicable for the landfill described in the data sheet, when it has an impact of a potential ELFM project. The goal is to mention the existence of relevant information that the stakeholder can consult.

**Regional policy encouraging ELFM:** list of public policies applicable in the region covered by the database, having an impact on a potential ELFM project. Here are some examples: green policies, circular economy and specific recycling policies, end-of-waste, declassification of buried waste that are not more seen as production residue, geolocation of the trucks, waste traceability...

- Text file

**Regional incentives encouraging ELFM:** list of public incentives for ELFM projects. Example: tax exemption or tax reduction for approved ELFM projects.

- Text file

**Dates of landfill ban:** dates of regional landfill restriction for some specific waste streams. A restriction can be a limitation (examples: increasing taxes or beginning a selective collection with sufficient coverage) or a total ban (no more organic waste in domestic landfills from a given time).

- Name of the stream (metals, organics, hazardous waste, EOL vehicles...)
- Regional code of the restricted stream (when exists)
- Date of applicability of the restriction
- Type of restriction: Boolean: restriction/ban

**Site specific ELFM facilitation procedures:** name and reference of legislative systems that can encourage ELFM operational projects on this particular landfill site, with their expiration date. Examples: a brownfield covenant signed with local government (Flanders) or a soil management covenant (Wallonia).

- Text file (Reference, signature date, expiration date, summary)

**Regional authorization for in-situ relandfilling:** reference of legislative text authorizing/forbidding relandfilling of ultimate waste in the same landfill.

- Text file

**Regional authorization for relandfilling at another landfill:** reference of legislative text authorizing/forbidding landfilling of ultimate waste coming from this landfill in other landfills. Conditions (nature of waste, tax level, tax exemption) must be specified.

- Text file

## Landfill ID card

This section gathers all administrative information related to the landfill described in the data sheet.

**Landfill name and synonyms:** usual name of the landfill or the place where it is located. As the landfill may appear under various names in various documents, all known denominations must be described in order to facilitate historical researches.

- Text file: main denomination

- Text file: Synonym 1
- Text file: Synonym 2
- Text file: Synonym 3

**Landfill reference:** identification of the landfill in its original database or file.

- Text file (to be general enough)

**ELIF reference:** identification of the landfill within an ELIF database. We suggest to use a common identification system in order to be able to share data between all NWE regions and propose to use the Classification of Territorial Units for Statistics Code incremented with an order number. The CTUS (French: NUTS = Nomenclature des Unités Territoriales Statistiques) is an EU geocode standard for referencing the subdivisions of countries for statistical purposes. Example: the first landfill encoded in ELIF and located in Walloon Brabant will be named BE31001, the next one BE31002, etc.

**Landfill coordinates:** geographical coordinates of the center/top of the landfill in the current system used by the regional authorities. The most common worldwide system is the WGS 84 (World Geodetic System), and the EU GALILEO positioning system will be fully operational around 2020.

- X
- Y
- Reference of the system

**Administration in charge:** identification of the public administrative unit in charge of the follow-up of this landfill (permitting, control, monitoring, post-management/aftercare period). Example in Wallonia: if the landfill is under operation → DGO3. If the landfill is abandoned → SPAQuE.

**Ownership:** name of the current owner(s) of the landfill and its (their) legal status. This information is important to evaluate the complexity of developing an ELFM project. Details of the ownership are not described here.

- Name of owner 1
- Status 1: public, private, both, unknown
- Name of owner 2
- Status 2: public, private, both, unknown
- Name of owner 3
- Status 3: public, private, both, unknown
- Name of owner 4
- Status 4: public, private, both, unknown
- Name of owner 5
- Status 5: public, private, both, unknown

**Landfill operator(s):** name of the operator(s) of the landfill with the date of its (their) intervention. Up to 5 operators are allowed. Operators may operate successively or simultaneously.

- Name of operator 1

- Date of beginning
- Date of end
- Name of operator 2
- Date of beginning
- Date of end
- Name of operator 3
- Date of beginning
- Date of end
- Name of operator 4
- Date of beginning
- Date of end
- Name of operator 5
- Date of beginning
- Date of end

**Legal status of the landfill:** legal status, for which we propose the following classification: legal covered by a permit, legal but without any permit, illegal, unknown or specific (in case of special status).

- List: Legal status

**Permits:** list of permits and authorisations with their dates and references. No more detail regarding permits will be given here.

- Text file: reference, date of authorisation, expiration date, nature of permit

**Landfill type:** landfill class according to EU Directive (i.e. Hazardous, Non-hazardous, Inert) when the classification is applicable. Please note that the main type of waste that will be encountered in the landfill is described in another field (see below) with more detail.

- List: Hazardous/Non Hazardous/Inert/Not applicable

**Landfill status and dates:** current status of the landfill, with begin and end dates. Several answers are possible, i.e. a landfill can be controlled (construction respecting legal requirements: water tightness, drainage, etc.) and still in operation or closed.

- Boolean: controlled/wild dump
- Boolean: abandoned/still in operation at data sheet date
- Boolean: rehabilitated/not rehabilitated
- Boolean: necessary to rehabilitate/not necessary
- Date: Begin of landfill operation
- Date: End of landfill operation
- Date: Begin of rehabilitation
- Date: End of rehabilitation
- Date: Begin of aftercare period
- Date: End of aftercare period

**Landfill monitoring:** information about the monitoring of the landfill by a public or private body. When monitored, the landfill can be either under operation or closed.

- Boolean: monitored/not monitored at data sheet date
- Text file: company/administration in charge of the monitoring

- Date: begin of monitoring
- Date: end of monitoring

**Fence/site protection:** information about the accessibility of the landfill, in order to identify risks from exposure to waste, biogas or leachate or risk of wild dumping by people who can access the site for various reasons.

- Text file

**Buried Volume:** evaluation of the landfilled waste volume. Specify how the volume, which is a very important information, has been measured or simply estimated.

- Number (m<sup>3</sup>)
- Boolean: measured/estimated
- Text file: method used for obtaining the volume

**Remaining Volume:** estimation of volume available to receive new waste (i.e. ultimate waste from another ELFM project) or materials (i.e. soil for shaping the final landfill after ELFM operations).

- Number (m<sup>3</sup>) – by default: 0
- Boolean: measured/estimated
- Text file: method used for obtaining the data

**Remediation costs:** estimation of rehabilitation costs in €. Rehabilitation can be temporary or final, so the given estimation must cover both of them.

- Number (€ excluding taxes, VAT, etc.) – if unknown: 0

**Aftercare costs:** estimation of post-management costs in €.

- Number (€ excluding taxes, VAT, etc.) – if unknown: 0

**Warranties given:** warranties given for rehabilitation & aftercare costs in €. This data can be found in permits.

- Number (€ excluding taxes, VAT, etc.) – if unknown: 0

**Studies:** list of available studies related to the landfill with references of the study (e.g. author, title of the study, journal, year of publication). Specify if the study is public or kept confidential. Specify where the studies can be consulted. Studies can include press articles, pictures, maps, advice of official bodies, environmental documents, among others.

- Text file

**Sampling:** list of waste samples collected, with references (e.g. name of the responsible, sampling date). Specify the nature of the samples (i.e. surface samples, boreholes, trenches, pits) and describe the performed analysis (i.e. chemical, physical, material-recovery oriented).

- Text file



## Surroundings

This section is related to the surroundings of the landfill, mainly its physical environment and sustainability aspects. It also gathers some relevant information for launching an ELFM project.

**Land planning:** official land use of the landfill and the immediate surroundings (1 km away from the site borders) regarding the national/regional legislation (industrial, agricultural, housing...).

- Text file

**Current use:** current use of the site of the landfill, regardless its official use: None, Cultivation, Natural reforestation, Use by local people (specify for which use), Use for renewable energies, Others.

- List
- Text file

**Territorial strategy aspects:** interest of the landfill site for the territorial development (i.e. located in an area affected by a territorial tool implemented or planned). In addition to the regional tools, each city or town can develop its own tools for redevelopment of the territory. Specify the references of the tools, if a redevelopment project of the area is planned and when it is expected to be realized. Example: urban redevelopment plan around the landfill from 2025.

- Text file

**Occupation:** list the various types of land use of land within a radius of 50 m around the landfill center (Houses, Industrial, Recreational, Economic, Agriculture, Forest, Green spaces).

- List (Present - Potential)

**Land pressure:** estimation of the development potential of the landfill area. Local estimated land price if possible. Criteria: price of housing, prices of the land, average income per capita, population density, unemployment rates, demographic predictions. Land pressure may be high, even if no specific territorial strategy exist.

- List

**Touristic area nearby:** presence of a touristic area nearby the landfill site.

**General Risk evaluation:** assessment of the main specific potential hazard presented by the landfill: Flood, Fire, Stability, Person accident (if the landfill is not fenced and easy to access...), Other. Please note that flooding may be evaluated regarding climate changes aspects. Risk related to groundwater are described hereunder in a specific field "Groundwater vulnerability".

- Check List

**Environmental issues:** known environmental issues associated with the existence of the landfill.

- Specific environmental issue (not related to water and geology)
  - Boolean: yes/no
  - Text file: short relevant description of the issue
- Surface water contamination
  - List: contaminated (estimated)/contaminated (measured)/high risk of contamination/medium risk of contamination/low risk of contamination/no risk of contamination/unknown
  - Boolean: analysis available/not available
  - Text file: short relevant description of the issue
- Geological context
  - List: Highly permeability soils or rocks/ Medium permeability soils or rocks/Low permeability (specified for the soil or rocks below the landfill)
- Groundwater vulnerability
  - Text file: Average level of upper groundwater table
  - List : contaminated (estimated)/contaminated (measured)/high risk of contamination/medium risk of contamination/low risk of contamination/no risk of contamination/unknown
  - Text file: short relevant description of the issue
  - Boolean: exploited groundwater/not exploited
  - List : landfill included in a drinking water protection zone : yes (close protection zone)/yes (extended protection zone)/no

**Social support:** identification of wishes of local residents or associations to see the landfill removed or reduced. Example: is there a resident committee? A project for landfill remediation? Information can be found through press releases, blogs, publications, etc.

- Boolean: yes/no
- Text file

**Biodiversity:** are there any flora or fauna that need to be protected on site? Example: endangered species such as eagle owls, calcareous grassland.

- Boolean: yes/no
- Text file
- Boolean - Site in Natura 2000 area : yes/no

**Erosion:** assessment of the erosion risks by surface water runoffs or water streams.

- List: none/weak/severe/potential

**Access for landfill mining operations:** evaluation of the accessibility conditions (for trucks and equipment) to the landfill. Distances are real distances and not as the crow flies.

- List: Heavy trucks access (>30T): yes/no/an access can be arranged
- Text file: Distance to main road (m)
- Text file: Distance to the nearest harbour (m)
- Text file: Distance to the nearest waterways (m)
- Text file: Distance to the nearest rail station (m)

**Facilities for landfill mining operations:** distance to a waste treatment unit or another operational landfill that can receive ultimate waste from an ELFM project (on site, <30 km, <50 km, <100 km).

- Incineration plant
- Cement factories
- Waste treatment plant (in general)
- Landfill for hazardous waste
- Landfill for non hazardous waste
- Mechanical biological treatment plant

**Leachates treatment plant on site:** description of the leachate treatment plant present on the landfill.

- List: exists and operational/exists and not operational (to be rehabilitated)/does not exist/unknown
- Boolean: Operational/To be rehabilitated
- Text file

**Leachates treatment plant nearby:** description of the nearest operational treatment plant that could receive leachates produced by the landfill (<10 km, < 20 km, <50 km).

- List
- Text file

## Landfill geometry

Regardless the nature of the waste deposit, this section describes the geometry and the engineering design (if present) of the landfill.

**Landfill Morphology:** shape of the landfill and its integration in the surrounding area: Mound/heap/hill, Depression/quarry, Open dump (waste spread on the ground with limited height, i.e. <3 m), Slope/along a valley, Lagoon/pond.

- List

**Surface:** we distinguish here the area occupied by the waste deposits and the total area of the landfill site, which can be quite different. Source of the data and the way the surface was assessed are important for further analysis.

- Total surface of the site (m<sup>2</sup>)
- Text file
- Total surface occupied by the waste deposits (m<sup>2</sup>)
- Text file

**Waste height/depth:** evaluation of the depth/ height of the landfill from surface to natural ground level. Source of the data and the methodology used to assess it are important for further analysis.

- Maximal height (above the natural ground level - +m)
- Maximal depth (below the natural ground level - -m)

- Average thickness of the waste deposits (m)

**Fragmentation:** this field describes the spatial distribution of the waste deposits (i.e. landfilled in a single place or in several locations).

- List: in one place/spread in several locations

**Stability of the waste mass:** this field describes the probability to encounter any issue related to the stability of the whole waste pile. "General Slope" and "water table" can be measured while "risk" is based on an appreciation hanging on the nature and age of waste materials, their thickness, their slope, the presence of a water table, field observations and experience of similar cases.

- General slope: steep slopes (more than 15° from horizontal)/gentle slopes (less than 15° from horizontal)/no slope
- Water table: water table within the landfill (<5 m depth)/water table within the landfill (<10 m depth)/no water table within the landfill/no information about the water table
- Risk appreciation for future excavation works: high/medium/low/unknown

**Top layer:** type and composition of the top layer of the landfill.

- List: geomembrane/mineral cover/soil/waste
- Boolean: watertightness/no specific watertightness layer
- Boolean: rainwater drainage/no specific rainwater drainage layer
- Boolean: gas drainage/no specific gas drainage layer

**Bottom layer:** type and composition of the bottom layer of the landfill.

- Boolean: watertightness (clay and/or geomembrane)/no specific watertightness layer
- Boolean: leachate drainage/no specific leachate drainage layer

**Emissions to air:** existence of (bio)gas and/or dust emissions.

- List: yes/no/unknown

**Biogas aerial collection system:** all information about a gas collection system placed in the landfill, especially if aerial system can hinder geophysics works.

- Boolean: yes/no
- Text file for short description: number of boreholes, trenches, lines of pipes, etc.
- List: pipes running in surface/ buried pipes /no pipes
- List: abandoned/in operation
- Date (starting date/ending date)
- List: flare/engine/no valorisation system

## Landfill Waste Materials

This section gathers all suitable information about the waste materials buried in the landfill.

**Dates:** dates of beginning/end of landfilling operations/rehabilitation.

- Date (beginning of landfilling)

- Date (end of landfilling)
- Date (beginning of rehabilitation operations)
- Date (end of rehabilitation operations)
- Date (beginning of gas collection)
- Date (end of gas collection)

**Main waste type:** list of the main known waste stream.

- List: municipal - household - domestic solid waste/inert waste (construction)/inert waste (industry)/industrial waste/military waste – UXOs/Mixed waste).

**Specific waste stream:** List of specific waste streams as dredging sludge/water purification sludge/gypsum/fly ashes/asbestos/slugs/mining waste/lime/contaminated soils/ Others. Specify the percentage of the total volume of the landfill occupied by this specific stream and indicate how this percentage was assessed (measured/estimated).

- Text file: percentage (%)
- List : data quality (measured/estimated)

**Radioactive waste:** this field describes the probability to encounter the presence of radioactive waste<sup>2</sup> in the landfill (assessed/possible/none/unknown).

- List

**Hazardous hospital waste:** this field describes the probability to encounter the presence of hazardous hospital or medical waste in the landfill (assessed/possible/none/unknown).

- List

**Hazardous military waste:** this field describes the probability to encounter the presence of hazardous military waste in the landfill (assessed/possible/none/unknown). The presence of UXO (unexploded ordnance) presenting a tremendous risk must be precised. UXO (grenades, bombs, etc.) usually comes from warfare, military exercises and dumping of ammunitions.

**Asbestos:** this field describes the probability to encounter the presence of free asbestos in the landfill (assessed/possible/none/unknown).

- List

**Other hazardous waste:** this field describes the probability to encounter the presence of hazardous waste (other than the ones mentioned above) in the landfill (assessed/possible/none/unknown).

- List

**Main physical state:** this field specifies main physical state of the waste.

- List : solid waste/powdered waste/sludge/liquid

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<sup>2</sup> Could be medical radioactive elements, or some lightning rods with an head containing Radium 226 or Americium 241, produced in the 80s.

**Leachates:** indicates presence of leachates within the landfill.

- List: yes/no/unknown

**Daily cover:** this field specifies if a daily cover was used during landfilling operation, the type of cover and its volume.

- Boolean: yes/no
- List: Type of cover: organic, mineral, synthetic
- Text file: Origin of cover products (if organic or mineral)
- % of the waste volume occupied by the cover (0 if synthetic)

**Waste composition:** we assume that the landfill can be described with maximum five contrasted layers based the RDM "resource distribution model"<sup>3</sup> designed by RAWFILL historical and investigation survey (geophysics and sampling campaign). A 2D or 3D map should be included to identify the different layer for which the following properties could be precised:

- Text file: Thickness of the layer (m)
- Text file: Volume of the layer (m<sup>3</sup>)
- Text file: Average density of the waste material in the layer (T/m<sup>3</sup>)
- Text file: Tonnes buried (T)
- List: Main physical state (solid/powdered/sludge/liquid)
- List: Waste homogeneity (*see below*)
- Text file: % fine materials (%) (i.e. materials having a grainsize lower than 40 or 50 mm.)
- List: Main type of waste
- Text file: Gas content (%)
- Text file: Water content (%)
- Text: Average T° (°C)
- Boolean: Presence of a water table (yes/no)
- Date: Beginning of the landfilling
- Date: End of the landfilling
- Text file: Estimation of the waste composition<sup>4</sup>
- Text file: Estimation of the recyclability potential<sup>5</sup>

**Waste homogeneity:** this field specifies if a layer can be considered as homogeneous or heterogeneous at small and large scales, following the definition given in the [WP T1.3.1. RAWFILL SWOT analysis deliverable](#):

	Homogeneous	Heterogeneous
At large scale (macro)	Only one layer of waste can be distinguished within the landfill:	More than one layer of waste can be distinguished within the landfill. Each layer has a

<sup>3</sup> See Deliverable WP T3.1.1. Resource Distribution Model.

<sup>4</sup> See waste description guideline in the [Deliverable WP T1.3.1 RAWFILL - SWOT analysis of landfill characterisation methods](#).

	<ul style="list-style-type: none"> <li>- One single waste stream (mono-landfill)</li> <li>- Several waste streams, totally mixed</li> </ul> <p>Any taken sample will have a similar composition.</p>	relatively homogeneous composition.
At small scale (micro)	Only one type of waste stream can be found in all the waste samples collected.	More than one type of waste stream can be found in all the waste samples collected.

- At large scale: Boolean (homogeneous/heterogeneous)
- At small scale: Boolean (only one stream/more than one stream)



## Contact

Feel free to contact us.

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