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MiDSafe

Advancing Post-Mining Waste Dump Safety and Sustainability
Grant Agreement Project No 101157379 – MiDSafe

Work Package 2

The European Coal & Lignite Mine Waste Dumps Database and
problems and threats associated with waste dumps

Deliverable No D2.3.

Report on the European Coal & Lignite Mine Waste Dumps
Database development

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1. INTRODUCTION

Underground mining leads to the generation of large amounts of waste, which, both in the past and present, is stored in surface landfills. This waste is generated at all stages of mine development and deposit exploitation, from shaft sinking, through deposit access, to exploitation, and in all technological operations related to the enrichment of the ore extracted to the surface. Our own experience shows that environmental hazards may arise within the landfill site where the waste is located, including:

- groundwater pollution,
- surface water pollution,
- air pollution,
- soil pollution.

Within landfills with a large mass of accumulated post-mining waste, deformations of the landfill substrate and its body may also occur, similar to surface mass movements. Mass movements within the landfill result in geotechnical hazards, causing, among other things:

- loss of stability of the landfill slopes,
- discontinuous deformations in the foreground of the landfill,
- changes in hydrogeological conditions,
- damage to buildings and technical infrastructure in the landfill area.

The most common causes of landslides and slope failures in mining areas include:

- natural causes,
- anthropogenic causes, including the impact of underground mining.

The loss of stability of slopes and embankments in mining areas depends mainly on:

- the extent and intensity of the impact of mining operations,
- the physical, mechanical, and rheological properties of the soil,
- rock mass vibrations,
- changes in hydrogeological conditions,
- landslide streams occurring on the slope.

The occurrence of geotechnical hazards is determined by many factors, including primarily:

- poor geotechnical parameters of the subsoil under the landfill and in its foreground,
- the presence of weak soils in the subsoil, forming slip surfaces,
- variation in terrain elevation in front of the landfill,

- waterlogging of the subsoil, affecting the increase in plasticity and creep of the soil,
- increasing load on the subsoil under the landfill from the stored waste,
- soil deformation caused by mining operations.

In summary, it should be noted that mining waste landfills are among the most complex earthworks, especially considering their geotechnical properties. These facilities vary in terms of their physical, mechanical, and strength properties, and therefore it is important to identify, analyze, and minimize geotechnical and other related hazards at mining waste storage sites.

In the context of the project, effective measures for monitoring geotechnical conditions and their evolution over time, as well as data collection and analysis, will help to better understand the behavior of landfills and thus improve safety by effectively tracking changes in slope stability, thereby ensuring increased stability.

As part of the MIDSAFE project, geological, geotechnical, and hydrogeological data for selected wastes are collected and analyzed, as well as archived waste disposal site designs, with particular emphasis on data such as:

- dimensions of the disposal site;
- date of construction of the disposal site (age);
- slope angles;
- types of subsoil;
- construction times of individual landfill layers;
- types of waste stored;
- critical properties of stored waste in the context of landfill stability;
- hydraulic phases and history;
- drainage methods;
- consolidation.

One of the important objectives of the project is to create a geotechnical database of existing landfills from lignite and hard coal mines in order to assess the associated risks and, on this basis, to create a feasible and practical online monitoring system.

This database, developed by GIG, is an ICT system that will ultimately minimize the risks inherent in the waste storage process. The database will contain risk factors (significance, predisposition, potential instability, intensity of the phenomenon), with particular emphasis on potentially destructive mudslides and landslides. Ultimately, the database will contain data on landfills in Poland, Greece, Romania, the Czech Republic, and Spain.

This tool has been designed in accordance with best practices in database design to ensure the integrity, performance, and scalability of the system.

The database is currently being developed and improved. In addition to its cognitive value, the database will enable effective management of information on landfills and stored waste and will ultimately support decision-making on minimizing the risks associated with landfills.

2. MAIN DATABASE FUNCTIONS

2.1. Technology Platform

The MiDSafe database is built on the Bubble.io platform, a no-code/low-code development environment that provides (**Figure 1**):

- visual development interface for rapid application building (User Interface Layer),
- built-in database management with flexible data types (Data Access Layer),
- workflow design (Application Logic Layer),
- user authentication and role-based access control,
- API integrations for external services (e.g., Google Maps),
- secure hosting with automatic scaling.

The platform supports both Development and Live database environments, allowing for safe testing of new features before deployment to production.

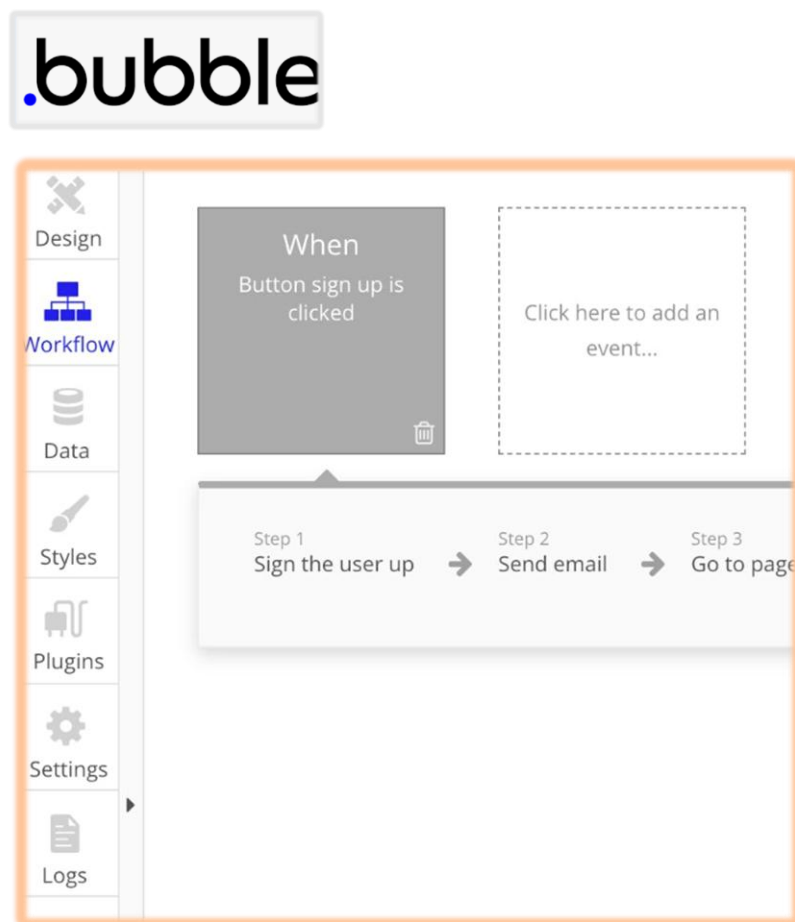


Figure 1. Bubble environment

2.2. MiDSafe application functionality

The MiDSafe application provides users with the following functionalities:

- collecting and sharing data on parameters characterizing dumps (literature data),
- filtering data (on parameters characterizing dumps) according to selected parameters,
- collecting and sharing data on parameters characterizing dumps and geomaterials (measurement data eg. GIS data, geomaterial characterization data),
- collecting and sharing other data (eg. report, article)
- supporting the process of assessing the stability of dumps,
- supporting the process of developing innovative materials to minimize geotechnical and environmental risks,
- visualization and reporting.

2.3. Functional Modules of the Application

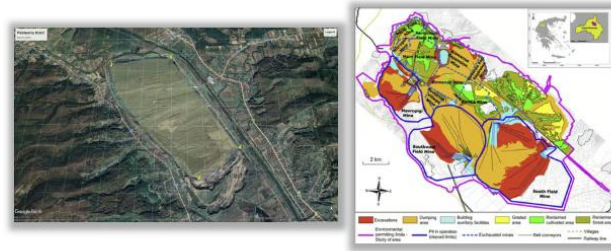
The MiDSafe application consists of several functional modules accessible through the main navigation menu. This section describes each module (**Figure 2**).



Figure 2. Functional modules of MiDSafe application

Module: *About Database*

The *About Database module* serves as the landing page for the MiDSafe application. It provides users the main functionalities of the database (**Figure 3**).



The aim of the MiDSafe project is to create a tool to assess mine dumps in the scope of the stability and support decisions in the field of risk minimization. The developed database system is enable access both the general information and stability parameters of mining dumps in partner countries: Poland, Greece, Romania, the Czech Republic.

- The MiDSafe DATABASE has the following functions:
- collecting and sharing data on parameters characterizing heaps,
 - collecting and sharing data on parameters characterizing heaps,
 - supporting the process of assessing the stability of dumps,
 - supporting the process of developing innovative materials to minimize geotechnical and environmental risks.

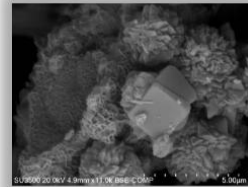
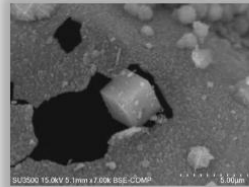
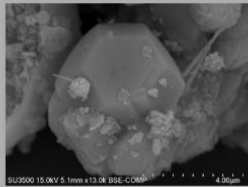


Figure 3. About Database page - MiDSafe application landing page

Module: Dumpsites

The Dumpsites module is the core component of the MiDSafe database, providing comprehensive access to mine waste dump data collected by all partner countries (**Figure 4**).

The module's key features are as follows:

- interactive Google Maps visualization with dumpsite locations,
- advanced filtering system with multiple criteria,
- save filtered dumpsite selections,
- name and organize custom reports.

The user can filter the data contained in the database according to predefined ranges, which are divided into 5 categories:

LOCATION DATA	PARAMETERS OF DUMP	GEOLOGICAL, GEOTECHNICAL AND HYDROGEOLOGICAL DATA
<p>Country</p> <p><input type="checkbox"/> Greece</p> <p><input checked="" type="checkbox"/> Poland</p> <p><input type="checkbox"/> Romania</p> <p>City</p> <p>Search Residue Type</p> <p>Types of site</p> <p><input type="checkbox"/> internal dump <input type="checkbox"/> open</p> <p><input type="checkbox"/> outer dump</p> <p><input type="checkbox"/> internal/outer dump</p> <p>Reclaimed land</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Partly</p> <p>Mining Plant Area</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p>Mine ownership boundary</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p>	<p>Lenght [m]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p> <p>Width [m]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p> <p>Level difference [m]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p> <p>Inclination [%]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p> <p>Volume [m3]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p>	<p>Types of dumped soils</p> <p>Search Residue Type</p> <p>Types of base-terrain soils</p> <p>Search Residue Type</p> <p>Presence of underground water</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p><input type="checkbox"/> Unknown</p> <p>Presence of mining voids / sinkholes</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Bearing capacity of the ground</p> <p><input type="checkbox"/> Lack <input type="checkbox"/> Good</p> <p><input type="checkbox"/> Unknown</p> <p>Past dump failures</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Past fires of dumps</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>

INFRASTRUCTURE AND ELECTRICITY GRID	MARKET, FINANCIAL, LEGAL AND SOCIAL ISSUES
<p>Access to electricity grid</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <hr/> <p>Distance from the nearest electricity grid [km]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p> <p>Existence of renewable energy installations</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <hr/> <p>Distance from the nearest renewable energy installations [km]</p> <p>from <input type="text" value="min"/> to <input type="text" value="max"/></p> <p>Access road to site</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <hr/> <p>Existing equipment that could be utilized for the construction of the RM-GES, or CB-GES</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>Social acceptance of related activities</p> <p><input type="checkbox"/> High <input type="checkbox"/> Medium</p> <p><input type="checkbox"/> Low</p> <hr/> <p>Promotion of investment in rehabilitation of post mining areas in your country/region</p> <p><input type="checkbox"/> High <input type="checkbox"/> Medium</p> <p><input type="checkbox"/> Low</p> <hr/> <p>Energy demand in (dump) region</p> <p><input type="checkbox"/> High <input type="checkbox"/> Medium</p> <p><input type="checkbox"/> Low</p> <hr/> <p>Existence of regulations related to sustainable development of post mining dumps</p> <p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p><input type="checkbox"/> Low</p>

The user can then save the filtering results and generate a report, which is available in the REPORTS tab.



Location data

Parameters of the dump

Geological, Geotechnical and Hydrogeological data

Infrastructure and electricity grid

Market, financial, legal and social issues

Filter ⓘ

Generate report ⓘ

Clear ⓘ

There is 152 filtered sites

Country

Czechia

Greece

Poland

City

Types of site

internal dump open

outer dump

internal/outer dump

Reclaimed land

Yes

No

Party

Mining Plant Area

Yes

No

Mine ownership boundary

Yes

No

Central Mining Waste Storage Facility
City: KNURÓW
Country: Poland

Reclamation area „A”
City: PIEKARY ŚLĄSKIE
Country: Poland

Area of Jedłownik Shaft
City: WODZISŁAW ŚLĄSKI
Country: Poland

Landfill at EC
City: PSZÓW
Country: Poland

Dump "Buków"
City: LUBOMIA
Country: Poland

Dump "Mariańska II"
City: CHORZÓW
Country: Poland

Dump at Wiejska Street
City: CHORZÓW
Country: Poland

Dump "Borowa II"
City: RUDA ŚLĄSKA
Country: Poland

Cones at the mine shaft Antoni
City: BYTOM
Country: Poland

Figure 4. Module: Dumpsites - the core component of the MiDSafe database

Module: *Reports*

The Reports module enables users to archive customized reports based on their filtered dump site selections generated in Dumpsite module (**Figure 5**). Users can save report (.csv file) or display the results on the monitor screen. After pressing the *MORE* button, the user receives a complete set of information about the selected dumpsite contained in the database (**Figure 6**).

The module's key features are as follows:

- retrieve previously saved selections,
- generate printable/exportable reports.

Module: *Data Collection*

The Data Collection module manages project documentation, including scientific articles, technical reports, and research datasets (eg. SEM/EDS data, GIS data) contributed by project partners (**Figure 7**).

The module's key features are as follows:

- document upload and management (button: *ADD NEW FILE*),
- categorization by document type: Article, Report, Data set, GIS data, geomaterial data, other (**Figure 7b**),
- information about association with Work Packages (eg. WP2) and partner attribution (e.g. GIG-PIB),
- file download functionality.

Module: *References*

The References module provides access to literature and bibliographic sources used throughout the MiDSafe project. It serves as a centralized repository for citations linked to dump site records (**Figure 8**).

Modules in Preparation

The following modules are currently under development and will be documented in future reports:

- Module: Geomaterials - data on geopolymer materials, synthesis methods, and characterization results,
- Module: Assessment of Dumps - tools and methodologies for evaluating dump stability and risk assessment.



REPORTS Your last 5 reports. Download (.csv / .pdf file) or view list.

KATOWICE	Aug 28, 2025 1:03 am			
GREECE	Aug 28, 2025 12:46 am			
MOJ RAPORT	Aug 28, 2025 12:29 am			

KATOWICE

COUNTRY	DUMP NAME	CITY	TYPE OF SIDE	RECLAIMED LAND	MINING PLANT AREA	LENGTH [m]	WIDTH [m]	LEVEL DIFFERENCE [m]	INCLINATION [%]	VOLUME [m³]	CONSTRUCTION DATE	
Poland	Dump at Pukowca Street	Katowice			Yes							More
Poland	Dump at Sportowa Street	Katowice			Yes							More
Poland	Dump at Ściegiennego Street	Katowice			Yes							More
Poland	Dump "Kostuchna"	Katowice			Yes	960	550	59		5752000	1900	More
Poland	Dump at former Maria Shafts	Katowice			Yes	660	460					More
Poland	Local landfill	Katowice			Yes	475	345					More
Poland	Dump Szopienice - East II"	Katowice			Yes							More
Poland	Dump at Ceglana Street	Katowice			Yes	1100	400					More

Figure 5. REPORTS Module - generation printable reports








PARAMETERS OF DUMP AT FORMER MARIA SHAFTS

Location data	Dump name:	Dump at former Maria Shafts
	Country:	Poland
	City	KATOWICE
	Coordinates	19.032975 50.189575
	Type of site	
	Reclaimed land	
	Mining Plant Area	Yes
	Land within the mine ownership boundary	
Parameters of the dump	Length [m]	660
	Width [m]	460
	Base height [m]	
	Top height [m]	
	Level difference [m]	
	Inclination [%]	
	Volume [m ³]	Yes
	Dump construction date: Building times of individual dump benches:	
Geological, Geotechnical and Hydrogeological data	Types of base-terrain soils	
	Types of dumped soils	
	Dewatering methods	
	Presence of mining voids / sinkholes	
	Bearing capacity of the ground	
	Past dump failures	no data
	Past fires of dumps	No /
	Critical properties of the dumped soil in the context of dump stability:	no data
Hydraulic phase and history	no data	
Infrastructure and electricity grid	Access to electricity grid	Yes
	Distance from the nearest electricity grid [approximately in km]	
	Existence of renewable energy installations (PV panels or wind turbines) in the greater vicinity	Yes
	Distance from the nearest renewable energy installations [approximately in km]	12,75
	Access road to site	Yes
	Existing equipment that could be utilized for the construction of the RM-GES, or CB-GES (eg. conveyor belts, railway equipment characteristics, etc)	
Market, financial, legal and social issues	Energy demand in your (dump) region	High
	Promotion of investment in rehabilitation of post mining areas in your country/region	
	Social acceptance of related activities	Medium
	Existence of regulations related to sustainable development of post mining dumps	Yes
<p>Data was obtained from publicly available sources and then analyzed. Publicly available sources included scientific articles, databased and websites: https://www.geoportal.gov.pl/ (Polish Geoportal of Spatial Information Infrastructure), https://www.opi-tpp.pl/. Distance from the nearest renewable energy installations was estimated based on the known location of the Installations: Toszek Wind Turbine, Strzelce Opolskie Wind Farm, Sławików Wind Park, Krzanowice Wind Farm, Myslowice Photovoltaic Farm.</p>		

Figure 6. REPORTS Module - display detailed information about the selected dumpsite

DATA COLLECTION

GIG-PIB	12/29/25	Article	WP 6	Detailed article describing advanced zeolite modification techniques, surface functionalization processes	
GIG-PIB	12/30/25	Article	WP 6	Scientific article presenting innovative research on geopolymer materials, their synthesis methods, structural characterization, mechanical properties, and potential applications in sustainable construction and environmental remediation technologies	
GIG-PIB	12/30/25	Report	WP 2	Technical report D2.3 deliverable outcomes for the reporting period, including detailed analysis of methodologies, results validation, and recommendations for future research directions	
GIG-PIB	12/30/25	Data set	WP 6	Partial results dataset containing scanning electron microscopy (SEM) measurements	
GIG-PIB	12/30/25	Data set	WP 6	Dataset of textural properties measurements for materials used in geopolymer and zeolite synthesis, including BET surface area analysis, pore size distribution curves, total pore volume data, micropore and mesopore characterization.	

(a)

Figure 7. DATA COLLECTION Module: project documentation base

Select data type (choose from the dropdown)

Select WP number (choose from the dropdown)

Data description

Other information

(b)



REFERENCE

Dumps from Poland Silesia region	Data was obtained from publicly available sources and then analyzed. Publicly available sources included scientific articles, databased and websites: https://www.geoportal.gov.pl/ (Polish Geoportal of Spatial Information Infrastructure), https://www.opi-tp.p.l/ . Distance from the nearest renewable energy installations was estimated based on the known location of the installations: Toszek Wind Turbine, Strzelce Opolskie Wind Farm, Sławików Wind Park, Krzanowice Wind Farm, Mysłowice Photovoltaic Farm.
Dumpsite - Soulou / Greece	Zevgolis_et_al. (2021) - Geotechnical Characterization of Fine-Grained Spoil Material from Surface Coal Mines. https://doi.org/10.1061/(ASCE)GT.1943-5606.0002550
Dumpsite - Soulou / Greece	Theocharis et al. (2022)-3D Numerical Analysis for the Valorization Potential of Spoil Heaps by Shallow Foundation. https://doi.org/10.3390/su14127363
Dumpsite - Soulou / Greece	Theocharis et al. (2024) - Probability distributions of geotechnical properties for heterogeneous lignite mine spoils. https://doi.org/10.1080/19386362.2024.2398328
Dumpsite - Soulou / Greece	Zevgolis et al. (2025) - Spatial Variability in Geotechnical Properties Within Heterogeneous Lignite Mine Spoils. https://doi.org/10.3390/geosciences15030097
Dumpsite - Amyntaion / Greece	Kavvadas, M., Roumpos, C., Servou, A., & Paraskevis, N. (2022). Geotechnical Issues in Decommissioning Surface Lignite Mines—The Case of Amyntaion Mine in Greece. <i>Mining</i> , 2(2), 278-296. https://doi.org/10.3390/mining2020015
Dumpsite - Kyparissia / Greece	Spanidis, P. M., Roumpos, C., & Pavloudakis, F. (2022). A Methodology combining IDEF0 and weighted risk factor analysis for the strategic planning of mine reclamation. <i>Minerals</i> , 12(6), 713. https://doi.org/10.3390/min12060713
Dumpsite - Kyparissia / Greece	Louloudis, G., Roumpos, C., Mertiri, E., Kasfikis, G., & Vasilelou, E. (2023). The Hydrogeological Conditions as a Crucial Factor for Creating Pit Lakes: The Case of Kyparissia Mine in Megalopolis, Greece. <i>Materials Proceedings</i> , 15(1), 2. https://doi.org/10.3390/materproc2023015002
Dumpsite - Kyparissia / Greece	Louloudis, G. (2017, August). The worth of hydro geochemical data factor analysis (PCA) in interpretation of underground water origin. Megalopolis lignite bearing fields mine water and regional waters relations case study. In <i>Proceedings of the 15th International Conference on Environmental Science and Technology, Rhodes, Greece (Vol. 31)</i> .
Dumpsite - Kyparissia / Greece	Sokratidou, A., Gkouvatsoy, E., Roumpos, C., Perdiou, A., Tsagkarakis, G., & Kaimaki, S. (2018, September). Innovative approaches to coal surface mine sites rehabilitation: A case study of Megalopolis lignite fields. In <i>Proceedings of the 14th International Symposium of Continuous Surface Mining, ISCSM2018, Thessaloniki, Greece (pp. 23-26)</i> .
Dumpsite - Thoknia / Greece	Spanidis, P. M., Roumpos, C., & Pavloudakis, F. (2022). A Methodology combining IDEF0 and weighted risk factor analysis for the strategic planning of mine reclamation. <i>Minerals</i> , 12(6), 713. https://doi.org/10.3390/min12060713
Dumpsite - Thoknia / Greece	Louloudis, G. (2017, August). The worth of hydro geochemical data factor analysis (PCA) in interpretation of underground water origin. Megalopolis lignite bearing fields mine water and regional waters relations case study. In <i>Proceedings of the 15th International Conference on Environmental Science and Technology, Rhodes, Greece (Vol. 31)</i> .
Dumpsite - Thoknia / Greece	Sokratidou, A., Gkouvatsoy, E., Roumpos, C., Perdiou, A., Tsagkarakis, G., & Kaimaki, S. (2018, September). Innovative approaches to coal surface mine sites rehabilitation: A case study of Megalopolis lignite fields. In <i>Proceedings of the 14th International Symposium of Continuous Surface Mining, ISCSM2018, Thessaloniki, Greece (pp. 23-26)</i> .

Figure 8. References Module - repository for citations linked to dump site records

3. Authorization System, Permissions, and Data Security

The MiDSafe application implements a role-based access control system to manage user permissions and ensure data security. The system defines three primary user roles:

1. unregistered user: access to module: About Database
2. registered user - User role:
 - as unregistered user and
 - access to modules: Dumpsites, Geomaterials, Assessment of Dumps, Reports, References
3. registered user - Project Partner role:
 - as User role and
 - access to module: Data Collection.

The table representing the user consists of the field described in Table 2.

Table 1. Database Structure : Users Table

Field	Type	Description
Email	String (unique)	User authentication identifier
First_Name	String	User first name
Country	String	User country (e.g., Poland)
UserRole	Option Set	Access level: User, ProjectPartner
UserSector	Option Set	Professional sector classification: Mining and Extractive Industry, Geotechnics and Environmental Engineering, Construction and Infrastructure, Land Reclamation and Waste Management, Energy Sector, Public Administration and Regulations, Transport and Logistics, Science and Research, Local Communities and Residents
Created Date	DateTime	Account creation timestamp
Modified Date	DateTime	Last profile update
Slug	String	user identifier

The following security measures are implemented to protect data integrity and user privacy:

- Privacy Policy - Published guidelines on data handling and user rights
- Website Data Use Agreement - Terms governing data access and usage
- Accessibility Statement - Commitment to inclusive access
- Secure HTTPS connection for all data transmission
- Environment separation (Development vs. Live database)
- Role-based data visibility restrictions

4. Access to the application

MiDSafe: European Coal & Lignite Mine Waste Dumps Database is available at the following link: <https://midsafemc.bubbleapps.io/>