



Geology, Geomorphology, Hydrology and Soils in Relation to the EIA for a new Thermal Treatment Facility (TTF)

As per ERA requirements for PA/O6O96/23

Report



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1 INTRODUCTION

This technical study identifies and describes the impacts on geology, geomorphology, hydrology and soils to fulfil the Environmental Impact Assessment (EIA) Terms of Reference (TORs) issued by the ERA for PA/06096/23 in June 2024.

The proposed development, hereinafter referred to as the “Scheme”, involves the construction of a new Thermal Treatment Facility (TTF) for the incineration of hazardous waste. The proposed development will form part of the ECOHIVE Complex and will operate in conjunction with the other waste management facilities at Magħtab.

1.1 PROJECT DESCRIPTION

The proposed facility incorporates the development of a new TTF for the incineration of hazardous waste collected in Malta. The project involves the construction of a new plant with two independent lines, with potential for a third line in the future. Currently, the existing TTF in Marsa receives 130-150 waste delivery vehicles daily and processes 5,000-6,000 tonnes of hazardous waste annually, expected to increase. The waste includes various types like clinical, pharmaceutical, sewage, and more. Establishing a new plant aligns with EU waste policy, promoting self-sufficiency and proximity in waste treatment to reduce environmental impact from waste transportation.

The site boundaries of the proposed TTF (Figure 1) encompass an aerial extension of 18,185m². The Scheme consisted of fallow agricultural fields bounded by rubble walls to contain arable land and control soil erosion. At the time of writing this report, the agricultural land had been stripped of the soil cover as part of the actions under the general development plan of the ECOHIVE Complex. In fact, this area is being subject to significant developments to improve the waste management targets of the Maltese Islands.



FIGURE 1: PROPOSED SITE FOR THE NEW THERMAL TREATMENT FACILITY (TTF)

2 TERMS OF REFERENCE

The Terms of Reference related to the study on land cover and land uses for the EIA were issued by the ERA in June 2024. They are replicated in Appendix 1 for reference.

3 METHODOLOGY

3.1 AREA OF INFLUENCE (AoI)

The Area of Influence (AoI) for the geological and soil study is restricted to the site extension while the geomorphological study is extended to a radius of about 600m from the site to include coastal areas as indicated in Figure 2. The AoI for the hydrogeology study focuses on the downstream part of the catchment of the site or in accordance with the regional groundwater flow model.

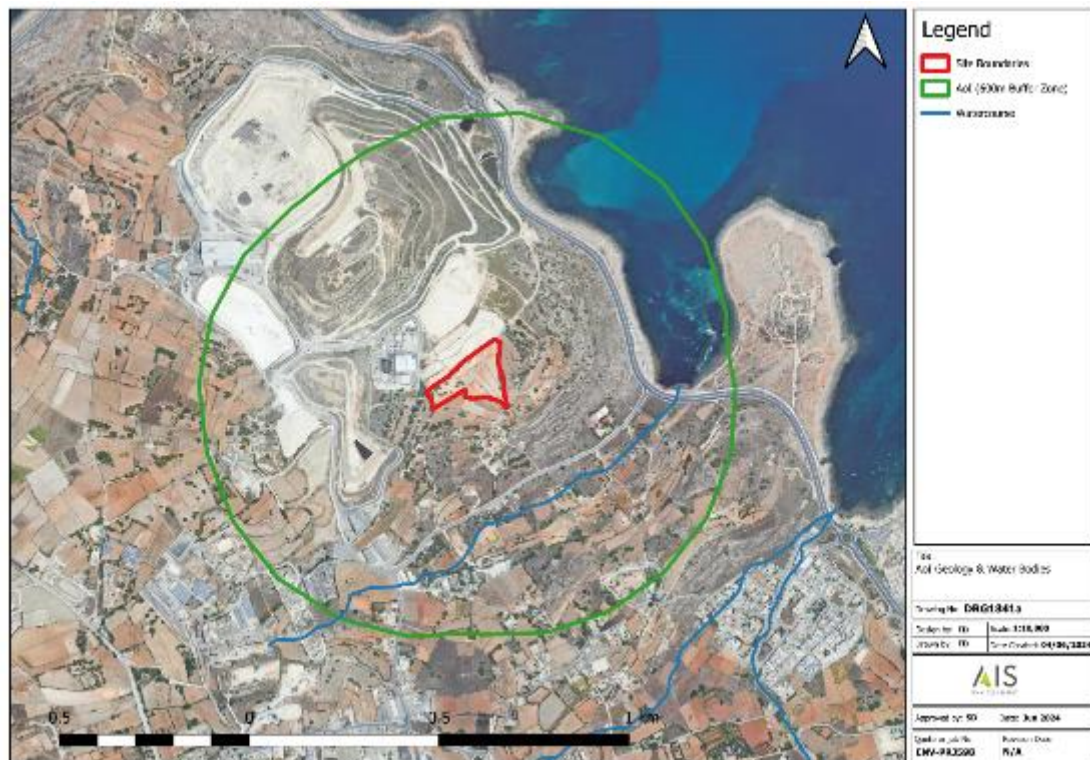


FIGURE 2: AREA OF INFLUENCE (AoI) FOR THE GEOLOGY, GEOMORPHOLOGY, HYDROLOGY AND SOILS STUDY

The AoI for geomorphological analysis encompasses an aerial extension of about 1.5km². A well-defined watercourse is located within the AoI (Figure 2). Run-off patterns originated from the Scheme are likely drained to Wied ta' Kieli with outlet to the coastline in Qalet Marku.

3.2 REGULATORY FRAMEWORK ASSESSMENT

3.2.1 The Strategic Plan for the Environment and Development (SPED)

The SPED issued by the Planning Authority in 2015, describes Malta's strategic vision on planning, environmental, economic and social matters to address overarching concepts of sustainable management of land and sea resources as well as the protection of the environment. A number of thematic objectives are directly applicable to the project and its effect on the biodiversity:

- Socio-Economic Development, Thematic Objective 1: To manage the available potential space and environmental resources on land and sea sustainably to ensure that socio-economic development needs are met whilst protecting the environment and limiting land take up within the Rural Area by:
 - Socio-economic development should ensure that rural areas are not exploited by uses which are not legitimate or necessary
- Socio-Economic Development, Thematic Objective 7: to promote the efficient use of resources including local stone, water and soil, and manage waste in a manner that safeguard natural processes, and minimises impacts on cultural heritage, landscape and human health by:
 - Supporting the implementation of the National Waste Management Plan and setting out site selection criteria for the location of waste to energy facilities
- Socio-Economic Development, Thematic Objective 8: to safeguard and enhance biodiversity, cultural heritage, geology and geomorphology by:
 - Controlling activities which might have an impact on areas, buildings, structures, sites, spaces and species with a general presumption against the demolition of scheduled and vernacular buildings
- Rural Objective 3: to guide development which is either justified to be located in the Rural Area in approved government policies, plans or programmes, or is incompatible with urban uses and where alternatives are not possible, to the Rural Areas away from protected areas and areas of high landscape sensitivity, preferably on Areas of Containment, previously developed land or existing buildings while ensuring the improvement of the quality of the rural environment by:
 - Setting out policy framework to control the location and design of such development and guide appropriate environmental measures
 - Controlling the cumulative effect of such development
 - Requiring compensation measures to enhance the rural environment

The development is at odds with the following SPED Objectives:

- Socio-Economic Development, Thematic Objective 7: to promote the efficient use of resources including local stone, water and soil, and manage waste in a manner that safeguard natural processes, and minimises impacts on cultural heritage, landscape and human health by:
 - Controlling the location of development to prevent soil sealing and erosion
 - Protecting agricultural land and gardens to prevent loss of soil and soil sealing
- Rural Objective 1: To facilitate sustainable rural development and the diversification of activities within the Rural Area to sustain agriculture and safeguard its distinctiveness by
 - Protecting good quality agricultural land from development

There are several justifications for this inconsistency. The centralisation of STM activities in Malta brings about many operational advantages in terms of logistics and transportation. Additionally, the grouping together of similar manufacturing areas may reduce environmental impacts, as the take up of land and any other spill-over effects will affect only one location rather than being spread out across many

areas in Malta. Soil consumption is minimised as the current status of the site is cemented.

3.2.2 Legislation for soil conservation

The following legislation outlines the requirements and responsibilities associated with activities that may impact soil deposits, particularly in relation to the proposed development of the TTF.

- Cap 549 – Environment Protection Act: ensures the protection and sustainable management of Malta’s natural environment. This Act establishes a comprehensive legal framework that mandates the responsible use of natural resources, including air, water, soil, and biodiversity.
- Cap 236 - Fertile Soil Preservation Act: specifically addresses the need to protect Malta’s limited fertile soil resources, which are vital for agricultural production and ecological balance.
- S.L. 236.02 - Preservation of Fertile Soil Regulations: These regulations complement the Fertile Soil Preservation Act by detailing specific measures necessary for preserving soil quality during development activities related to the proposed development.

The environmental regulations in Malta highlight the importance of protecting the environment through sustainable management of natural resources such as soil, air, and water. They require individuals and organizations to take proactive measures to prevent environmental harm, especially regarding the degradation of fertile soil and its impact on ecological systems. Authorities are empowered to enforce these regulations, conduct monitoring, and ensure compliance to maintain environmental integrity.

The regulations also mandate thorough assessments for projects with significant environmental impacts, requiring evaluations of potential effects on various receptors. Permits are necessary for activities that disturb soil, along with management plans outlining how soil will be handled during development. Best practices for conserving soil quality and promoting sustainable agricultural practices are encouraged, while community involvement is recognized as essential for fostering a culture of sustainability and enhancing public awareness of environmental issues.

3.2.3 Standards for rock investigations

Underground investigations aimed at assessing the geotechnical properties of the rock underlying the Scheme must adhere to standards and codes of practice to ensure the reliability and accuracy of the findings. These include:

- BS 5930:2015: provides comprehensive guidelines for conducting site investigations to assess the suitability of locations for construction and civil engineering projects. It emphasizes the importance of understanding site characteristics that can affect design and construction. The standard covers various aspects, including legal, environmental, and technical considerations,

and outlines procedures for conducting desk studies, field reconnaissance, and detailed ground investigations. Key updates in this version include compliance with Eurocodes, new information on geophysical surveying, and updated guidance on investigating contaminated sites.

- BS-EN 1997:2004: is part of the Eurocode framework and provides general rules for geotechnical design. It establishes principles for ensuring safety, serviceability, and durability in geotechnical engineering. The standard outlines requirements for assessing ground conditions, designing foundations, and evaluating stability against various forces. It aims to harmonize design practices across Europe, ensuring that structures are built safely and effectively while considering local environmental conditions.
- BS EN 1997-2:2007: complements Part 1 by focusing specifically on ground investigation and testing methods. It provides detailed guidance on how to conduct geotechnical investigations to gather reliable data about soil and rock properties. The standard covers various testing methods, including in-situ tests and laboratory analyses, ensuring that investigations are thorough and that the resulting data are suitable for informed decision-making in design processes.

3.2.4 The Water Framework Directive (WFD)

The EU Water Framework Directive (WFD) provides a comprehensive framework for the protection and management of water resources within the European Union. The scope of the WFD is broad, encompassing inland surface waters, transitional waters, coastal waters, and groundwater. The directive promotes an integrated, holistic approach to water management, with a focus on the river basin as the fundamental unit of analysis and planning.

At the core of the WFD are the key objectives of achieving good ecological and chemical status for all water bodies by 2027, preventing the deterioration of water body status, and promoting sustainable water use based on the long-term protection of water resources. To achieve these objectives, the directive requires EU Member States to undertake a thorough characterization of their water bodies, including the identification and delineation of surface water bodies (such as rivers, lakes, and coastal/transitional waters) and groundwater bodies.

The assessment of the current status of these water bodies, based on physical, chemical, and biological elements, is a crucial step in the WFD's implementation. The WFD also emphasizes the importance of monitoring, requiring Member States to establish comprehensive programs to assess the status of their water bodies, including both water quality and quantity parameters.

Incorporating these key elements from the EU Water Framework Directive into the regulatory framework assessment of the EIA will ensure that the protection and management of geology and water bodies are comprehensively addressed in line with the overarching EU legislation on water resources.

3.3 UNDERGROUND INVESTIGATIONS

The geological properties of the rock underlying the Scheme were analysed through the drilling of five (5) exploratory boreholes. The rock cores recovered from the exploratory boreholes were object of geotechnical and contamination testing. Geotechnical investigations were carried out throughout the length of the boreholes while two boreholes were used for contamination testing at different depths. Kindly refer to separate Technical Study for land and groundwater contamination testing.

The geological properties of the rock underlying the Scheme were assessed through the drilling of five (5) exploratory boreholes. The rock cores extracted from these boreholes underwent geotechnical and contamination testing. Geotechnical investigations were conducted along the entire length of each borehole, while two specific boreholes were designated for contamination testing at various depths. For detailed findings on land and groundwater contamination testing, please refer to the separate Technical Study.

The proposed drilling plan for the installation of exploratory boreholes is provided in Table 1 and Figure 1Figure 3.

TABLE 1: PROPOSED EXPLORATORY BOREHOLES AND SAMPLING DEPTHS OF INVESTIGATION

ZONE (EXPLORATORY BOREHOLE)	GPS COORDINATES (INDICATIVE) (WGS84 – 33N)	PLANNED MAXIMUM EXCAVATION DEPTH (M BGL)	NO. OF CORE SAMPLES	SAMPLING DEPTH(S) (M BGL)
A (A1)	449832.73276, 3977790.97690	3.25	0	-
A (A2)	449866.46880, 3977782.09899	3.25	0	-
A (A3)	449902.74139, 3977767.13338	9.50	3	1.5, 3.0 and 5.0
B (B1)	449907.30716, 3977852.86858	3.85 to 4.35	1	1.0
C (C1)	449944.59437, 3977793.00613	-1.90 (fill)	0	-

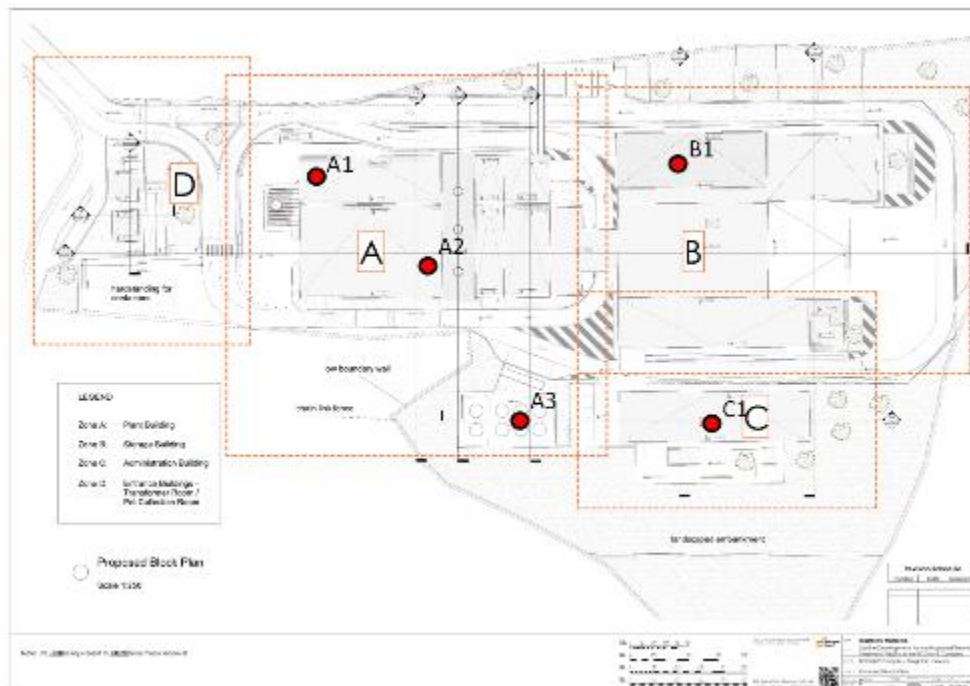


FIGURE 3: PROPOSED SAMPLING LOCATIONS (MARKED IN RED). SITE PLAN NOT SCALED

3.3.1 Borehole Drilling

Drilling and sampling of rock cores was performed by an accredited laboratory according to EN ISO/IEC 17025:2017. Boring was carried out in accordance with the provisions of BS EN ISO 18674-1:2015.

Soil removal from the site created access challenges for standard drilling equipment and water bowzers needed for drillings. As a result, boreholes were drilled using a Hilti portable hand drilling machine. However, this method limited the drilling depth to a maximum of 6 meters below ground level (GL).

3.3.2 Rock core properties

Borehole cores were photographed, examined and logged. The following parameters were measured from the core samples:

- Ground conditions (i.e., description of strata, depths, graphical legend, etc.),
- Rock Quality Designation,
- Total Core Recovery,
- Solid Core Recovery,
- Fracture Frequency,
- Any possible mechanical disturbance to the samples.

Reporting of borehole drilling will be carried out in accordance with the recommendations of BS 5930, 1999 “Code of practice for site investigations”.

3.4 IMPACT ASSESSMENT

The Expert evaluated the potential impacts arising from the construction and operation of the proposed Scheme on the geology and water bodies. The potential impacts also provided a basis for comparison between the existing conditions and the new conditions established during the operation of the Scheme.

The following information, where available, has been provided for each of the identified impacts:

- Project phase (construction or operational phase)
- Policy importance
- Extent of effect (local, national or international)
- Duration (temporary or permanent)
- Type (beneficial or adverse)
- Reversibility (reversible or irreversible)
- Sensitivity of receptors (high, medium or low)
- Probability of occurrence (certain, likely, uncertain, unlikely or remote)
- Scope for mitigation or enhancement (very good, good or none)

Based on the above criteria, the Expert assessed the significance level of each of the identified impacts. Different criteria were used for the different components of the study, as summarised in Table 2 to Table 10.

TABLE 2: DURATION OF IMPACT CRITERION DESCRIPTION

DURATION OF IMPACT

Permanent	Impact would still be detectable following decommissioning of project
Temporary	Impact would persist throughout the phase of project under consideration only

TABLE 3: EXTENT OF IMPACT CRITERION DESCRIPTION

EXTENT OF IMPACT

Widespread	Impact is expected to affect in the entire area of study and/or may extend beyond the boundaries of direct intervention into adjacent areas
Localised	Impact is expected to affect receptors in the immediate vicinity of its source

TABLE 4: CONSEQUENCES OF IMPACT CRITERION DESCRIPTION

CONSEQUENCES OF IMPACT

Direct	Changes that result from the cause-effect consequences of interactions between the environment and project activities
Indirect	Changes that result from cause-effect consequences of interactions between the environment and direct impacts
Cumulative	The cumulative consequences of environmental impact refer to the gradual and long-term effects that result from the combined impact of various disturbances or stressors on an ecosystem over time.

TABLE 5: EFFECT OF IMPACT CRITERION DESCRIPTION

EFFECT OF IMPACT

Adverse	A negative effect on the sustainability of the resource under consideration, which are distinguishable from background fluctuations
Beneficial	A positive effect on the sustainability of the resource under consideration, which are distinguishable from background fluctuations

TABLE 6: REVERSIBILITY OF IMPACT CRITERION DESCRIPTION

REVERSIBILITY OF IMPACT

Reversible	The state of the resource is expected to return to baseline state following cessation of the source of impact
Irreversible	The state of the resource is not expected to return to baseline state following cessation of the source of impact

TABLE 7: SENSITIVITY OF RESOURCES TO IMPACT CRITERION DESCRIPTION

SENSITIVITY AND RESILIENCE OF RESOURCES TO IMPACT

High	The resource under consideration is highly susceptible to a detectable deviation from the background state and its general dynamics
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SENSITIVITY AND RESILIENCE OF RESOURCES TO IMPACT

Moderate	The resource under consideration is vulnerable but able to tolerate a degree of detectable deviation from the background state and its general dynamics
Low	The resource under consideration is highly tolerant to a detectable deviation from the background state and its general dynamics

TABLE 8: PROBABILITY OF IMPACT OCCURRING CRITERION DESCRIPTION

PROBABILITY OF IMPACT OCCURRING

Inevitable	Impact will occur irrespective of any mitigation measures taken
Likely	Impact may occur despite the implementation of mitigation measures
Unlikely	Impact would only occur in cases of major mitigation failure
Remote	Impact would only occur in exceptional circumstances
Uncertain	Probability of impact cannot be predicted reliably due to missing information or unknown factors

TABLE 9: IMPACT SIGNIFICANCE CRITERION DESCRIPTION

IMPACT SIGNIFICANCE

Major	The effect on the existing state of the feature under consideration will lead to a high or large-scale change in its resilience
Moderate	The effect of the existing state of the feature under consideration will lead to an observable but contextually restricted change, which is sufficiently important for its long-term resilience
Minor	The effect on the existing state of the feature under consideration will lead to no, low or small-scale change that will not alter its resilience

TABLE 10: RESIDUAL IMPACT SIGNIFICANCE CRITERION DESCRIPTION

RESIDUAL IMPACT SIGNIFICANCE

Major	The effect on the existing state of the feature under consideration will lead to a high or large-scale change in its resilience after application of mitigation measures (if any) and impact cessation
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RESIDUAL IMPACT SIGNIFICANCE

Moderate	The effect of the existing state of the feature under consideration will lead to an observable but contextually restricted change, which is sufficiently important for its long-term resilience after application of mitigation measures (if any) and impact cessation
Minor	The effect on the existing state of the feature under consideration will lead to low or small-scale change that will not alter its resilience after application of mitigation measures (if any) and impact cessation
Negligible	The effect on the existing state of the feature under consideration will lead to no significant change that will alter its resilience after application of mitigation measures (if any) and impact cessation

4 BASELINE STUDY

4.1 IDENTIFICATION OF RECEPTORS

The examination of baseline conditions related to geology, geomorphology, hydrology, and soil characteristics is conducted subsequent to the identification of specific environmental receptors that could potentially be affected by the proposed development of the TTF in Malta. Potential receptors include:

- **Geology:** the Maltese Islands are primarily composed of young sedimentary rocks of marine origin, predominantly limestone. This geological composition influences soil formation and the overall landscape. The geological characteristics, including the presence of carbonate formations, play a significant role in groundwater movement and the stability of geomorphological structures.
- **Soils:** are essential for supporting biodiversity and agricultural productivity. They provide habitats for various plant and animal species, influencing the overall health of ecosystems. Despite their limited quality, Maltese soils allow for the cultivation of crops, making sustainable soil management practices crucial for enhancing fertility and ensuring food security.
- **Geomorphology:** topographical features of the site, including low-lying shores, rocky coasts, and karst landscapes contribute to habitat diversity and ecological dynamics within the region. Understanding geomorphology is essential for predicting how construction might influence local drainage patterns, sediment transport, and habitat integrity.
- **Hydrology:** Malta's hydrology is characterized by limited natural freshwater resources and a vulnerability to contamination. The identification of freshwater elements is crucial for their protection.

4.2 GEOLOGICAL SETTING

The site lies on Globigerina Limestone (GL) geological formation in between two faults of different orientation (Figure 4). Lower Coralline Limestone (LCL) is found outcropping surrounding the Scheme and within the AoI.

The GL formation is predominantly composed of the tests of planktonic foraminifera, specifically the genus *Globigerina*, which are microscopic marine organisms. The formation is recognized for its yellow to pale-grey color and fine-grained texture, resulting from the accumulation of these tiny carbonate shells over time.

Globigerina Limestone is the second oldest rock formation in the Maltese Islands, covering approximately 70% of the land area. It typically forms a gently rolling landscape due to its erosion-resistant properties. The limestone varies in thickness, ranging from about 23 meters to over 200 meters in different locations, and is divided into three members: Lower, Middle, and Upper Globigerina Limestone, separated by layers of phosphorite pebbles.

This limestone formation plays a crucial role in local architecture and construction; it is commonly referred to as "franka" in Maltese and is extensively used for building materials across the islands.

The LCL is the oldest exposed rock formation in the Maltese Islands, primarily formed during the late Oligocene epoch. This limestone is characterized by its hard, pale grey texture and is predominantly composed of carbonate sediments, including the tests of coralline algae and various marine fossils.

The Lower Coralline Limestone forms steep cliffs along the western coastal areas of Malta and Gozo, creating dramatic landscapes that are resistant to erosion.

This limestone formation is divided into four members: Maghlaq, Attard, Xlendi, and Il-Mara, each named after the regions where they are predominantly found. The Lower Coralline Limestone is not only geologically significant but also economically important as it serves as a valuable resource for the construction industry in Malta.

Additionally, this formation plays a crucial role in local hydrology by holding freshwater reserves, making it essential for water supply in the region. Its hard and durable nature has made it a preferred material for building structures throughout Malta's history.

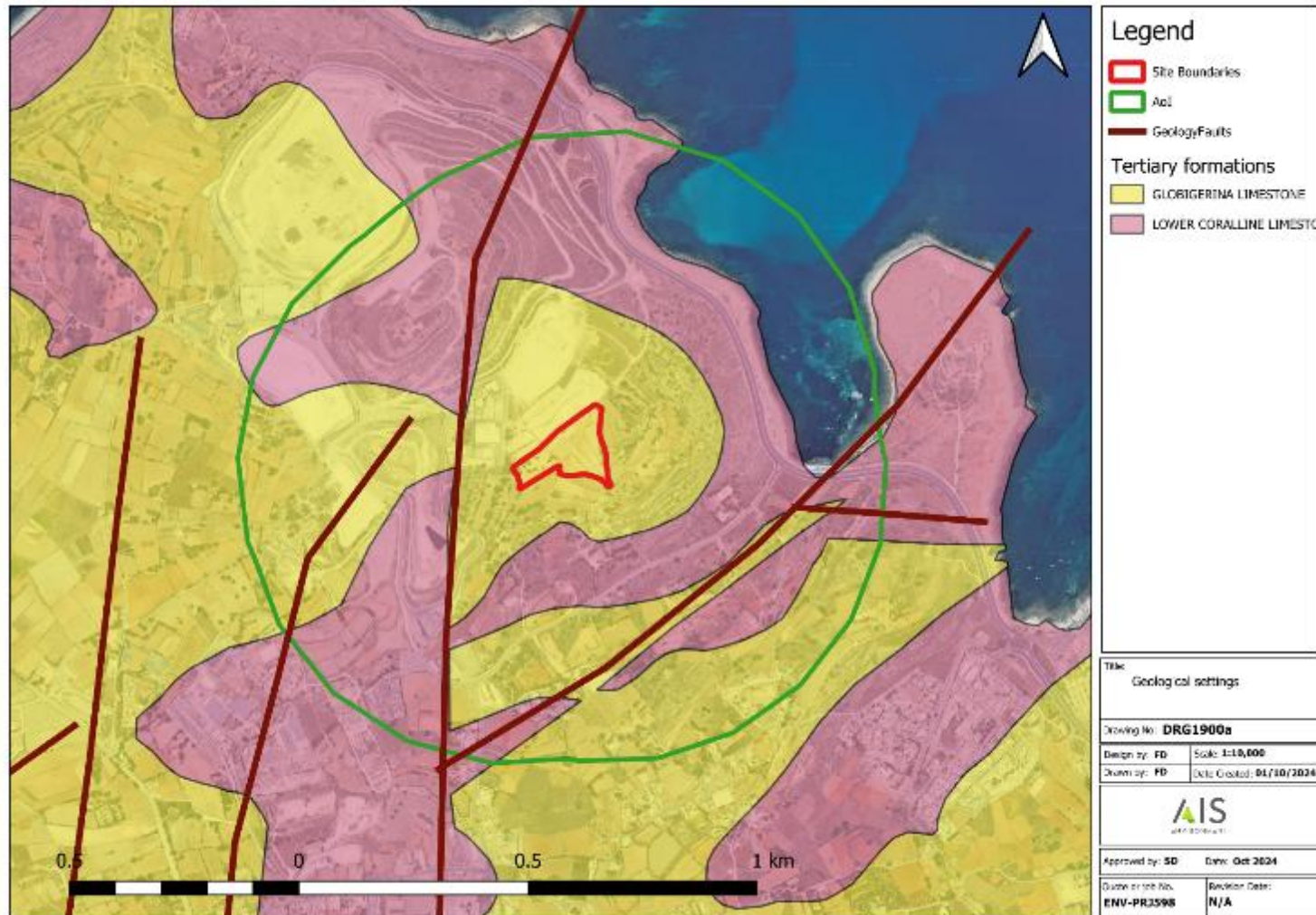


FIGURE 4: GEOLOGICAL MAP

4.2.1 Geology at site

The geological conditions at site were analysed through the drilling of five (5) exploratory boreholes and full recovery of rock core samples up to 6m in length for a total drilling of 22m. Six unconfined compressive tests on intact rock specimens from the retrieved borehole core, to ISRM suggested methods.

The drilling plan of the underground investigations undertaken as part of this study is presented in Figure 3 and Table 1. Additional results from drilling campaigns undertaken as part of other development zones within the ECOHIVE Complex were considered (Figure 5).

Bedrock pertaining to the Lower Member of the Globigerina Limestone Formation (LGL), is exposed at the surface in all five drilled boreholes. The retrieved LGL core material may be described as bioturbated, rust stained, fine grained, wackestones, which are associated with occasionally frequent calcified patches and core sections. When probed with a geological hammer, the LGL core material was observed to fall primarily within the 'moderately weak to moderately strong' strength category.

A considerable number of discontinuities were intersected in all boreholes. These discontinuities are evidenced through the presence of soil traces, red soil, caliche and caliche traces, calcite and calcite traces, white staining, black mottling, and rust staining.

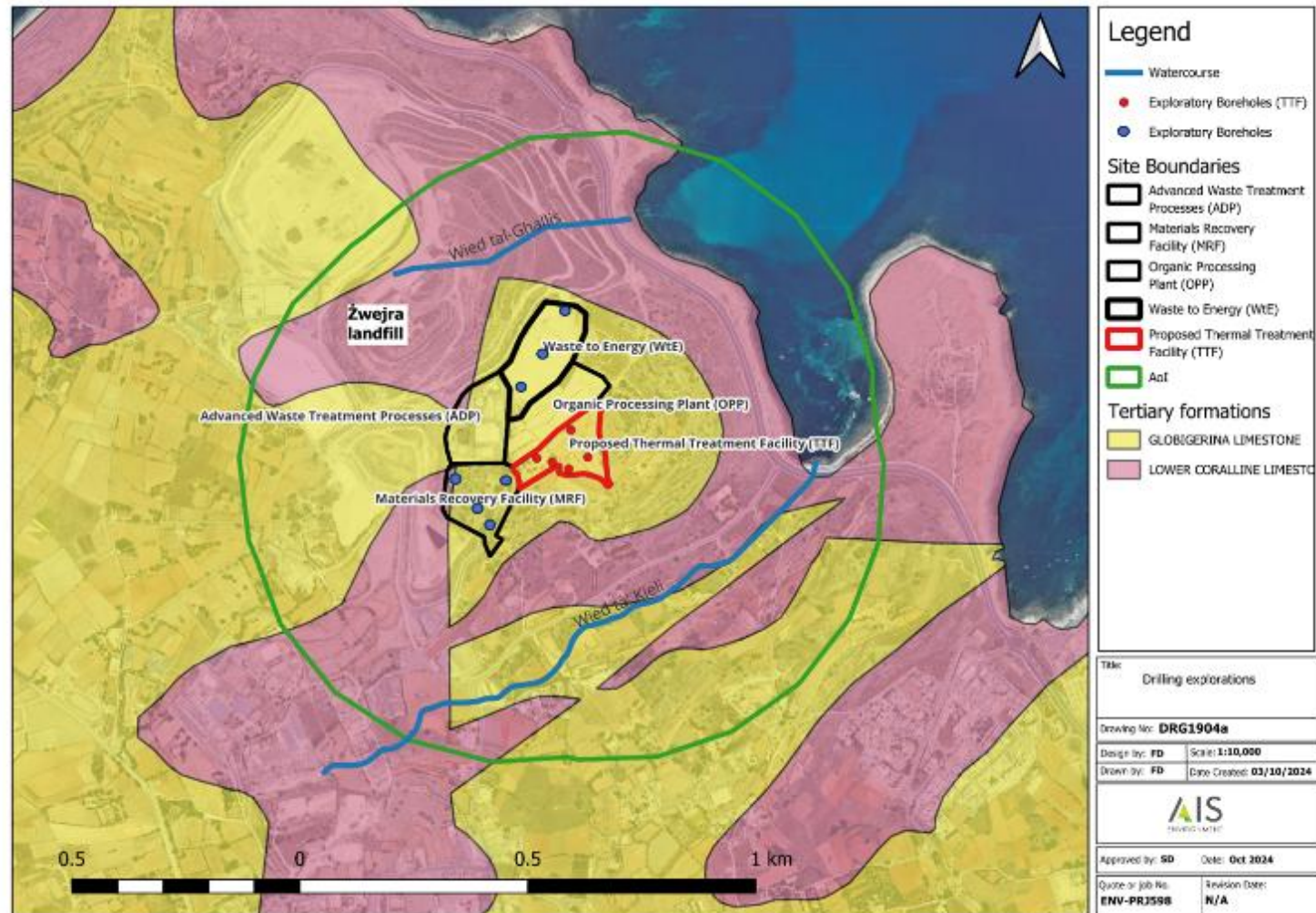


FIGURE 5: EXPLORATORY BOREHOLES DRILLED IN SITES ADJACENT TO THE PROPOSED TTF

In Figure 6 the Total Core Recovery (TCR), the Solid Core Recovery (SCR) and the Rock Quality Designation (RQD) are plotted for all boreholes and are corrected to elevation levels. The TCR is a measure of the proportion of core recovered of both solid and non-intact quality to the total length drilled. It may result that the rock is friable to an extent that the drilling sampler would not be capable of retrieving it from the ground. The SCR is the ratio of solid core recovered to total length drilled while the RQD is the ratio of the solid core pieces that are longer than 100mm to the total length drilled. The SCR and the RQD apply to rock only, and therefore not used for soils. For the purposes of the RQD only natural discontinuities are taken into consideration and any drilling induced cracks are ignored.

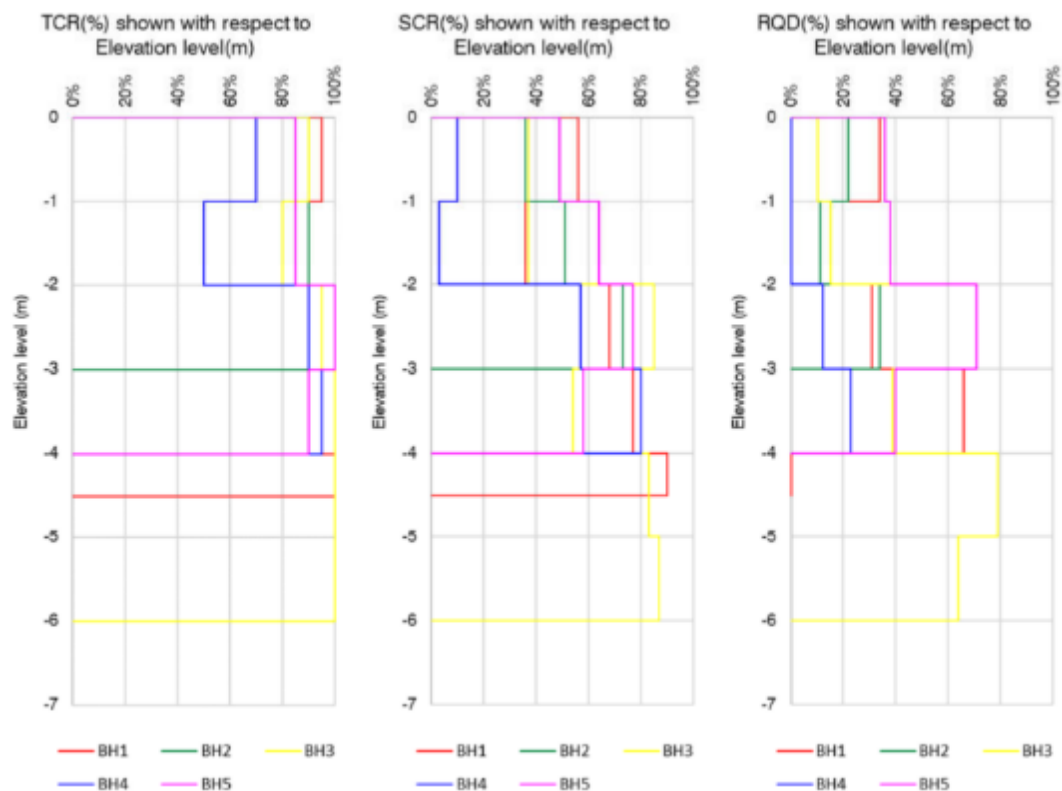


FIGURE 6: TOTAL CORE RECOVERY (TCR), SOLID CORE RECOVERY (SCR) AND ROCK QUALITY DESIGNATION (RQD) PLOTS

Laboratory tests were carried out to assess the strength and pore structure characteristics of bedrock underlying the site. This was achieved by carrying out unconfined compressive strength measurements in accordance with the recommended methods of the International Society for Rock Mechanics (ISRM). The ultrasonic pulse velocity and the bulk density were measured for each test specimen, immediately before crushing the specimen in the compression machine. The moisture content was then determined from intact pieces of the crushed specimen by placing some of these in an oven for 24 hours.

Unconfined compression tests revealed that the average dry unit weight is 18.35 kN/m^3 and the average porosity is 0.31. The corresponding void ratio

is 0.45 and the degree of saturation varies between 34% and 75% across the drilled depth. Such variation is normal in this type of measurement, and could also be due to some of the cores drying out during transportation and processing in the laboratory.

The scatter of results for unconfined compression is wide, with strength values varying between 4.08MPa and 24.27MPa with an average of around 13.14MPa. The highest value of 24.27MPa is not typical of this material and should be considered as an outlier. Without this value, the average strength is 10.91MPa. Results are summarized in Table 11.

TABLE 11: SUMMARY OF RESULTS FROM UCS TESTS AND SPECIMEN PREPARATION

PARAMETER	GS (ASSUMED) - MG/M ³	BULK UNIT WT - KN/M ³	DRY UNIT WT - KN/M ³	VOIDS RATIO	POROSITY	DEGREE OF SATURATION - %	SATURATED UNIT WT - KN/M ³	UNCONFINED COMPRESSIVE STRENGTH - MPA	MOISTURE CONTENT - %	PULSE VELOCITY -
Minimum	2.7	18.42	17.26	0.30	0.23	34.04	20.68	4.08	5.10	2.17
Maximum	2.7	22.07	20.34	0.53	0.35	75.89	22.61	24.27	13.39	3.41
Average	2.7	19.84	18.35	0.45	0.31	50.27	21.36	13.14	8.13	2.88

Similar geotechnical results were found within other sites at the ECOHIVE Complex.

4.3 SOILS

The Scheme site was stripped of the soil that supported arable land during preliminary archaeological investigations that were requested by the Superintendence of Cultural Heritage (SCH) Malta. A relatively thick layer of soil remains in the adjacent fields, which continue to be actively farmed. The soil present at the site, as well as that in the adjacent fields, is part of the L'Inglin complex. Additionally, Xaghra and San Biagio series soils are found within the AoI.

L'Inglin Complex primarily consists of clayey soils that are derived from the weathering of the underlying geological formations, particularly the limestone strata prevalent in the region. The L'Inglin Complex is notable for its high clay content, which contributes to its plasticity and water retention capabilities. This makes it suitable for various agricultural practices, as it can support crops while retaining moisture. The soil is typically dark in colour, indicating a rich organic matter content, which further enhances its fertility. In terms of geology, the L'Inglin Complex is associated with the underlying Lower Coralline Limestone and other limestone formations. These parent materials influence the soil's mineral composition and physical characteristics. The complex plays a crucial role in local agriculture, supporting the cultivation of various crops in the region.

Xaghra Series is primarily composed of clay loam and is derived from calcareous parent materials, particularly influenced by the weathering of the underlying geological formations, such as the Globigerina Limestone. This soil is typically recognized for its reddish-brown colour, which results from the presence of iron minerals within the soil. It generally exhibits a shallow depth, often ranging from 20 to 60cm, making it suitable for various agricultural practices. The soil is known for its good structure, although it can be prone to compaction under certain conditions. This soil type is commonly used for cultivating a variety of crops, including cereals and vegetables. However, its nutrient availability can be limited due to the high calcium carbonate content, which can affect plant growth by influencing nutrient uptake. Despite these challenges, the Xaghra Series remains an important agricultural resource in Malta, particularly in areas where traditional farming practices are employed. In terms of hydrology, the Xaghra Series has moderate water retention capabilities, allowing for effective moisture management in agricultural settings. Its properties make it suitable for terracing and other land management practices aimed at maximizing agricultural productivity while minimizing erosion.

San Biagio Series is primarily classified as a xerorendzina, which indicates that it has developed from the weathering of calcareous parent materials, particularly from the Globigerina Limestone. The San Biagio Series is distinguished by its light brown colour and silty loam texture, which contributes to its agricultural suitability. The soil typically exhibits a humus-deficient profile with a distinctive mull-like horizon, making it well-structured yet low in nutrient availability. This series is often found in terraced fields, where it supports various crops due to its ability to retain moisture moderately well. In terms of depth, the San Biagio Series generally has a shallow profile, ranging from 20 to 60cm, and is characterized by a relatively uniform texture from the surface down to the bedrock. The organic matter content in this soil type is typically low, averaging around 2% to 5%, which can limit its fertility but still allows for productive agricultural practices when managed properly.

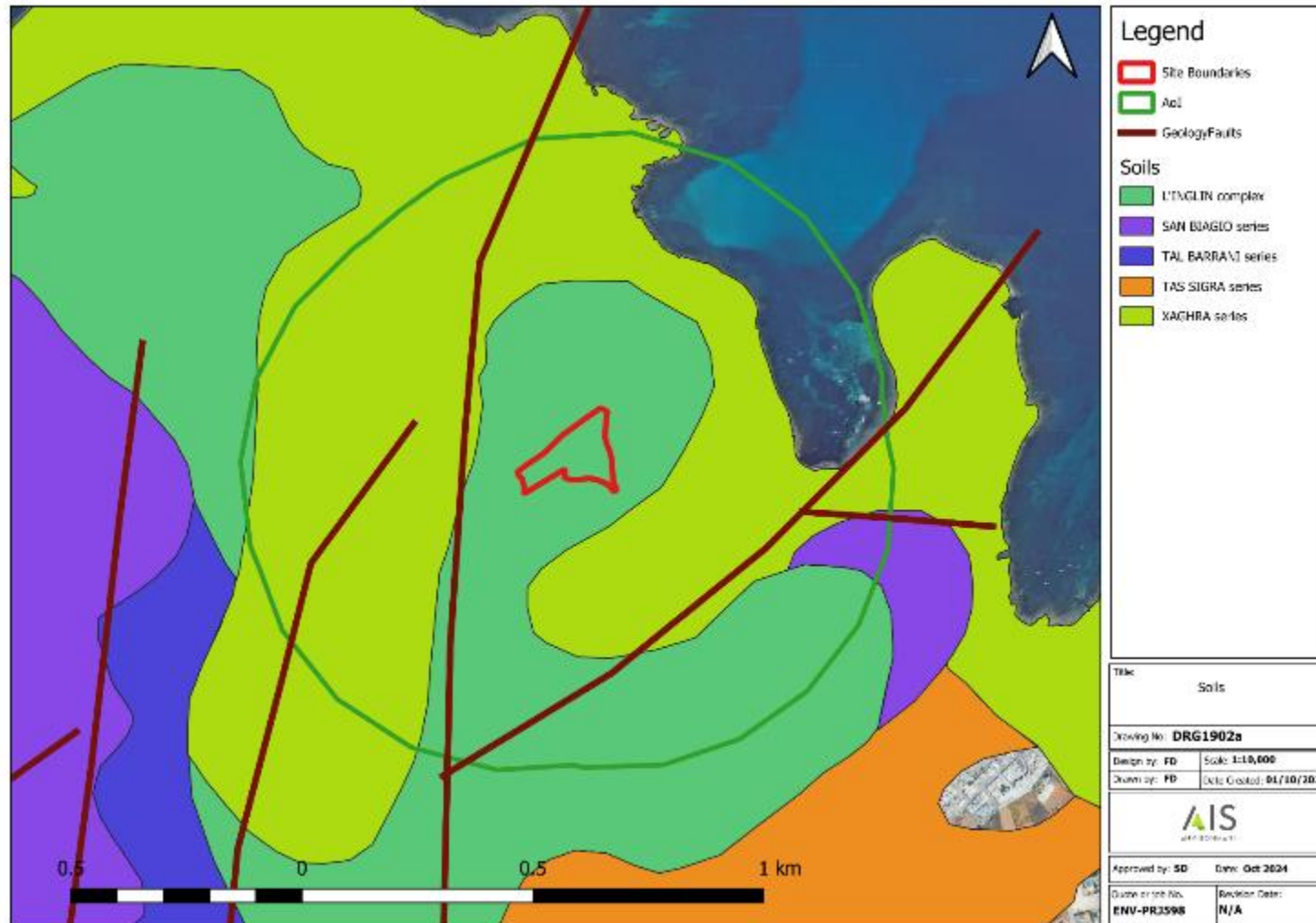


FIGURE 7: SOILS MAP

4.4 GEOMORPHOLOGICAL AND HYDROLOGICAL CONDITIONS

The Scheme is entirely encompassed by the water catchment basin of Wied ta' Kieli (Figure 8). Another watercourse is present within the AoI at the North of the site, namely Wied tal-Ghallis. Due to their limited aerial extent, neither of these catchment basins was included in the Preliminary Flood Risk Assessment (PFRA) or the Flood Hazard Maps and Flood Risk Management (FHRM) for the Malta River Basin District.

The topography of the site gently dips toward the Wied ta' Kieli watercourse, with an altitude ranging between 30 and 37 m above mean sea level (amsl). The highest elevations in the AoI, located to the West of the site, reach approximately 60 m amsl. This elevated terrain creates a watershed between two adjacent water catchment basins. Run-off is collected and directed through preferential stream paths, ultimately converging toward watercourses situated in the valleys with outlet to the sea. This topography is characteristic of the horst and graben structures that define the Northern region of Malta.

Rainfall precipitated on the hills or from the Scheme partly infiltrates underground, evaporates and another percentage generates run-off. Heavy rainfall is likely to generate intermittent surface water bodies in Wied ta' Kieli outflowing to Qalet Marku. Although specific historical data on flooding events in Wied ta' Kieli may not be extensively documented, the region's topography and hydrological conditions contribute to runoff that can lead to flash floods. The combination of steep slopes and urban development in the surrounding areas exacerbates the risk of flooding, as water is quickly funnelled into the watercourse. Climate change and urbanization highlights the increased vulnerability of this area to such natural events.

The outlet of Wied ta' Kieli corresponds to Qalet Marku where surface water is drained. The coastal area features flat limestone outcrops typical of the Eastern area of Malta. Qalet Marku is identified as a coastal unit limited by two cliffs at North and South. The intermittent surface water bodies generated during high precipitation events outflow into this coastal unit. In between these two outlets, a number of channels drain run-off throughout the coastline.

No natural freshwater resources are identified within the AoI. In fact, the groundwater qualitative status of freshwater-lens systems in areas near the coastline are highly saline due to seawater intrusion mechanisms and therefore not suitable for human or agricultural consumption. The only known source of groundwater is a public borehole located about 500m upstream from the site. The runoff or infiltration patterns generated from the site are unlikely to affect this borehole.

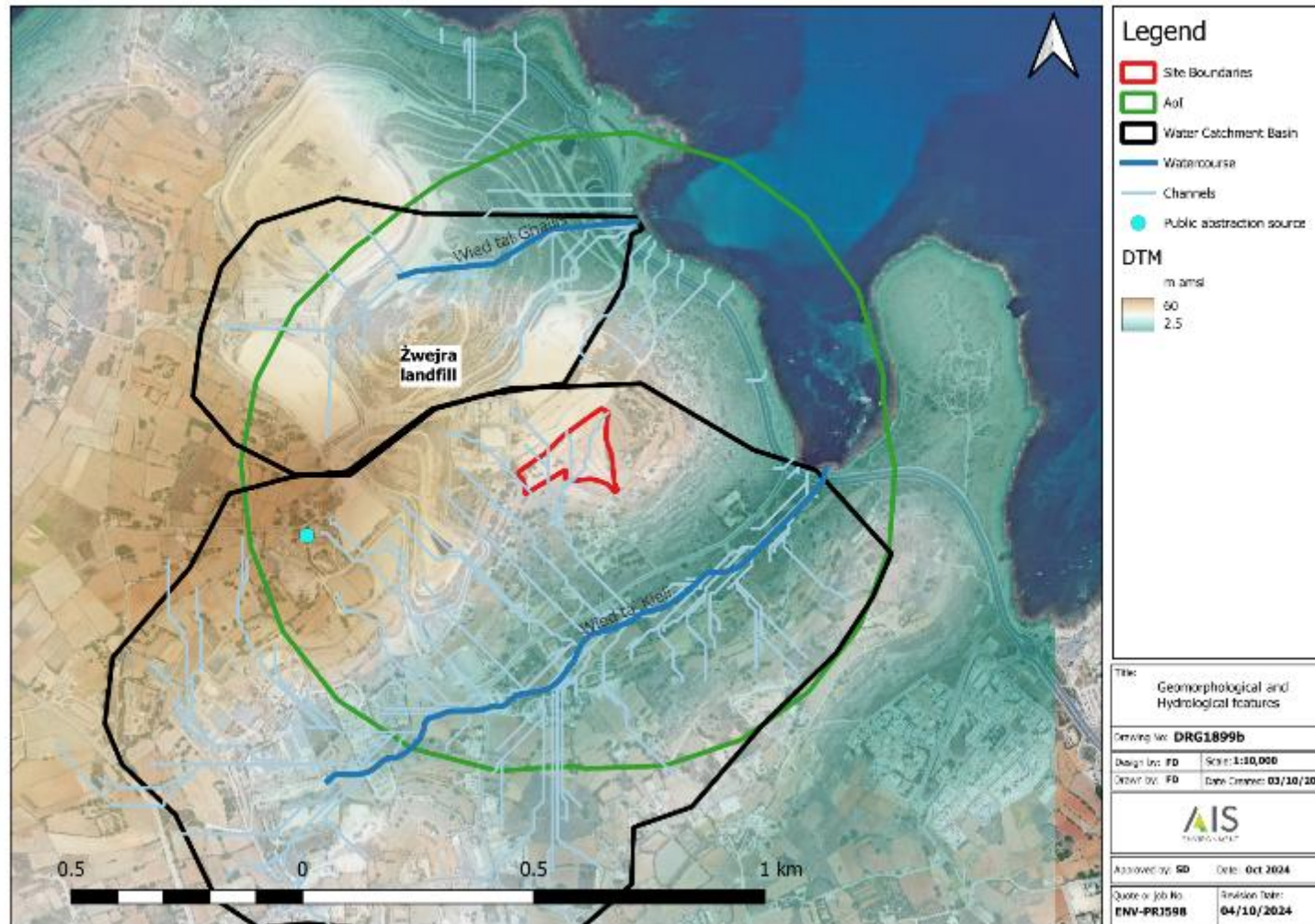


FIGURE 8: GEOMORPHOLOGICAL AND HYDROLOGICAL MAP

5 IMPACT ASSESSMENT

5.1 CONSTRUCTION PHASE

The construction target date for the Scheme is still unknown but the overall construction phase should not take more than 19 months. The construction of the Scheme is divided into phase as follows:

- Phase 1: The site will undergo preparation, hoarding will be added around the site, loose material will be cleared and excavation works will begin. As of the time of writing this report, the site has already undergone preparation.
- Phase 2: Following Phase 1, the foundation will be set out and lower-level walls will be constructed at various points.
- Phase 3: Phase 3 involves further excavation and movement of backfill to be utilised to relevant areas. Moreover, engineering works of site with backfilling up to the relevant area will take place. Any backfill which will not be utilised will be removed from the site and will be subsequently landfilled.
- Phase 4: The next phase involves formalisation of landscaped areas with transplanted elements, inclusive of further hoarding.
- Phase 5: The area will then be landscaped with transplanted vegetation.
- Phase 6: Construction of the building structure.
- Phase 7: Commissioning of the proposed Scheme.

5.1.1 Waste generation

The type of waste which will be generated during the construction phase of the proposed TTF is difficult to determine at the time this report is prepared, as it includes various streams such as construction waste, excavated rock, domestic waste and wastewater. The topsoil was removed as part of the general development plan of the ECOHIVE Complex.

Although of limited site extent, soil removal can generate major impacts related to erosion and sedimentation. When the topsoil is removed, it exposes underlying rock layers, making them more susceptible to erosion by wind and water. This can lead to a loss of fertile soil and degradation of the land. Additionally, eroded materials can be transported to nearby watercourses, causing sedimentation that may harm aquatic ecosystems by disrupting habitats and reducing water quality. Surrounding agricultural fields may also be affected due to nutrient depletion in topsoil which can lead to reduced crop yields and overall agricultural productivity.

A significant amount of geological rock will be lost through the construction of the proposed TTF leading to a moderate impact. This loss is primarily due to the extensive excavation required to prepare the site for development. The excavation process will not only remove surface layers but also disrupt underlying geological formations.

The amount of excavation rock is expected to be about 8,640m³. Ground contamination tests have confirmed that the material is non-hazardous and suitable

for backfilling on site, therefore the impacts outlined above are mitigated through the re-use of said material.

The geological impact of this construction extends beyond mere rock removal. The disturbance of the site can lead to increased erosion and sedimentation in surrounding areas, affecting local ecosystems and water quality. Dust generated during excavation may disperse into the environment, potentially contaminating nearby watercourses and affecting biodiversity.

5.1.2 Dust dispersion

Excavation and construction activities may lead to additional indirect impacts, particularly through the generation of fine particulate matter. This particulate matter can disperse beyond the boundaries of the development site due to wind and stormwater runoff. Dust carried by the wind may settle on the ground and be transported away from the site through rainwater runoff into adjacent protected valley systems or infiltrate underground.

The bioaccumulation of particulate matter resulting from dust dispersion during construction activities poses a threat to the geological and hydrological environment. Contaminant concentrations can increase in accumulation areas, creating a burden on human health. Potential impacts include:

- Pollution of geological layers;
- Decreased quality of surrounding soils used for agriculture;
- Pollution of watercourses and the marine environment.

The environmental impact is likely to be major; however, mitigation measures need to be implemented to minimize dust dispersion into the environment.

5.1.3 Ground Stability

The ground investigations have established that it is likely to have the building under development based on several foundations being supported directly on the rock. Several factors shall be taken into account during the design stage of the building foundations. These factors include:

- Failure mechanisms
 - Bearing capacity failure (or rotational failure) below strip and pad foundations;
 - Intense bearing pressures as a result of eccentric foundations close to the site perimeter.
- Excessive differential settlement of foundations on rock
 - Soil-infilled cracks can be compressed under the applied structural loads;
 - Weathered rock.

Although the bearing rock exhibits high stability parameters, the impact is likely to be moderate due to the intensity of fractures disrupting the compact rock matrix. The

forecast of geotechnical instability factors incorporated in the final design of foundations will further reduce the risk of building collapse.

5.1.4 Spillages

Spillages that occur during the transportation or storage of hazardous substances on construction sites can pose major adverse geological and hydrogeological impacts. When such materials leak onto exposed soils or unsealed ground surfaces, they can permeate the subsurface layers, leading to the contamination of underlying geological strata. This is particularly concerning in areas with permeable soils or fractured rock formations, which facilitate the downward migration of pollutants. From a hydrogeological perspective, these contaminants can reach groundwater systems, potentially affecting aquifers used for potable water or agricultural irrigation. Depending on the nature and volume of the spillage, the impacts may be long-lasting and require complex remediation measures to restore environmental quality and protect human health. Operational Phase

5.1.5 Hazards resulting from the plant use

The treatment of waste through a TTF results in various types of emissions and effluents during the waste treatment processes. The primary categories can be described as follows:

- Greenhouse Gas Emissions
- Air Pollutants
- Solid Residues
 - » Ash and Sludge: may contain heavy metals and other hazardous materials. This requires careful management and disposal to prevent soil and water contamination.
- Liquids
 - » Leachate: in some cases, it can form from stored waste materials, especially if not fully contained. This leachate may contain a variety of contaminants that can pose risks to groundwater and surface water bodies.
 - » Wastewater: wastewater will be produced from administration offices or related use of plant employees' restrooms. Proper management of wastewater has been planned through an appropriate water management report.

All the substances listed above, which are released during the collection, storage, and incineration of waste in a TTF, pose a major impact on soil and water environmental matrices. All of these hazards require careful monitoring and management to mitigate their environmental impact. Mitigation measures aimed at halting the emission and dispersion of the above listed hazards likely resulting from the operation of the TTF are described in the following chapter and in greater detail in technical requirements, design, and water management reports.

As part of the air dispersion model carried out in this EIA, a 6-week air quality monitoring campaign was undertaken with the objective of identifying the average

daily concentrations of PM_{10} and NO_2 . This study revealed that the forecasted annualization factors of 0.85 and 0.96, for PM_{10} and NO_2 respectively achieved a Corrected Annual Average (CAA) significantly lower than the Annual Limit Value (ALV). Moreover, the development of the deposition fallout model at a stack height of 25m shows that there are no significant variations in the impacts on air quality. The only receptor worth mentioning corresponds to an agricultural land ($35^{\circ}56'22.21''N$, $14^{\circ}26'45.34''E$) located 0.43km away from the chimney stack. However, the forecasted impact is minor adverse.

The study also evaluated the potential effects of bulk material deposition from TTF emissions on the surrounding soil. It concluded that the anticipated deposition levels will remain below established threshold limits, and as such, the resulting impact is considered negligible.

6 MITIGATION MEASURES

6.1 CONSTRUCTION PHASE

The LEGAL NOTICE 340 OF 2022 - CONSTRUCTION MANAGEMENT SITE REGULATIONS, 2022 should be enforced to avoid the aforementioned impacts from being generated in the first place and to ensure that environmental degradation is kept as low as possible. These regulations provide details on the containment and transportation measures for loose construction material on site and in transit, and other measures to prevent carrying out and/or depositing particulate matter.

Some of the proposed mitigation measures related to construction best practices are highlighted below:

- **Reuse or Recycle Excavated Waste:** Implement strategies to reuse or recycle excavated materials wherever possible, reducing waste and minimizing environmental impact.
- **Site Hoarding and Dust Suppression:** Hoarding should be set up (in line with the L.N.340 OF 2022 - CONSTRUCTION MANAGEMENT SITE REGULATIONS, 2022) along the construction site to minimise dispersion of particulates.
- **Silt Traps and Erosion Control:** Utilize silt traps and sediment control measures to prevent soil erosion and manage runoff effectively.
- **Oil-Water Interceptors:** Install oil-water interceptors to prevent contamination of surface water and groundwater from construction high risk activities related to the handling and storage of hazardous fluids, if used. While there is no specific information about oil-water interceptors in the context of construction a TTF, the use of such systems is consistent with best practices for environmental protection and risk management in industrial settings if the use hazardous fluids are forecasted.

6.2 OPERATIONAL PHASE

To mitigate impacts on ground contamination and hydrogeology during the operation of the proposed TTF, several operational measures can be implemented. These include:

- **Implementing precautionary measures to prevent greenhouse gas emissions:** technical specifications and basic design measures include
 - » cold storage rooms for waste containers;
 - » drawing primary and secondary combustion air from the feeding areas to keep these areas under slight vacuum;
 - » housing the shredder in a closed room maintained under slight negative pressure through suction by the combustion air fans.
- **Installing various pollution abatement and control systems** along with continuous emissions monitoring systems.
- **Regular maintenance of ash discharge system:** ash and sludge discharging systems should be periodically maintained to prevent soil and water contamination.

- Water management solutions: all process water streams generated shall be treated and reused to the extent possible and where it is found to be economical and environmentally feasible.
- Implementing waste handling protocols: all vehicles transporting waste are properly covered to prevent spills and leaks during transit. Additionally, designated unloading areas should be equipped with containment systems to manage any accidental discharges.
- Using environmentally friendly alternatives for hazardous substances: where possible, substituting less harmful materials in operations minimizes the potential for soil and water pollution.
- Regular training for employees on best practices for waste management and spill response: this training should emphasize the importance of adhering to established protocols to prevent contamination incidents.

By integrating these measures into the facility's operations, the TTF can effectively mitigate risks related to ground contamination and protect local hydrogeological conditions.

7 CUMULATIVE IMPACTS

The construction and operation of the proposed Thermal Treatment Facility (TTF), when considered alongside other planned waste management developments within the ECOHIVE complex, are expected to contribute cumulatively to environmental impacts on soil, geology, and hydrogeology.

During the construction phase, the TTF will involve significant excavation (approx. 8,640m³ of rock), topsoil removal, and the generation of dust and construction waste. The loss of rock strata is classified as a moderate adverse impact. These activities mirror those of other ongoing or proposed developments within the complex, thereby compounding effects such as localised erosion, sedimentation, dust dispersion, and loss of agricultural topsoil. Dust dispersion from such works is expected to yield major adverse impacts. Though individually manageable, the collective disturbance from multiple facilities increases the risk of degradation to surrounding land and nearby agricultural fields, particularly through nutrient depletion, reduced soil productivity, and minor sedimentation of watercourses. The stability of the construction pit is also to be monitored as the cumulative impact from all the construction activity taking place simultaneously in the area may lead to moderate adverse impacts. Accidental spillages during transportation or storage of hazardous substances from the various construction sites may also lead to major adverse geological impacts. The deviation of C&D waste from landfill is a beneficial cumulative impact.

The operational phase of the TTF will add to regional air emissions and the risk of soil and water contamination through the release of pollutants. While modelling indicates the TTF's direct pollutant load is within acceptable thresholds and impacts on air quality and soil are minor to negligible, the presence of other emission sources in the ECOHIVE complex such as the Waste to Energy facility, elevates the potential for cumulative impacts to minor adverse at R27.

8 RESIDUAL IMPACTS

Residual impacts are the effects that are expected to persist after the implementation of the proposed mitigation measures. Despite the comprehensive adoption of these strategies, several unavoidable residual impacts ranging from negligible to minor adverse are expected. These are anticipated during both construction and operational phase of the project.

During the construction of the TTF, particularly during excavation works, there will be a permanent loss of geological layers within the footprint of the site, which could affect local ecosystems and surrounding soil health. Additionally, temporary dust accumulation is likely to occur, especially in areas adjacent to hydrological features connected to the scheme.

The risk of temporary contamination of geological formations and watercourses due to spillage incidents poses a significant concern. Specific measures included in the design report to prevent these spillages are to be followed and emergency plans implemented to minimize the diffusion of pollutants into the environment.

In accordance with the Air Dispersion Model developed as part of this EIA, the operation of the TTF may pose a threat to the health of soils and crops production identified with an agricultural area (35°56'22.21"N, 14°26'45.34"E) located 0.43km away from the chimney stack.

9 MONITORING PROGRAMME

The stability of construction pits shall be monitored by a geologist or geotechnical engineer with the aim of preventing potential ground collapses due to unforeseen events. During the operational phase, structure settlements shall be closely monitored with the objective of ensuring that operational settlements do not exceed the limits identified during the design stage of the project.

The monitoring of pollutant levels around the Scheme is crucial to ensure that they are within limits, and to enable periodic monitoring and maintenance of the abatement technologies. Further details on this monitoring program are provided through the Air Quality Study.

10 SUMMARY OF IMPACTS TABLE

IMPACT TYPE AND SOURCE			IMPACT RECEPTOR		EFFECT AND SCALE							PROBABILITY OF IMPACT OCCURRING (INEVITABLE/ LIKELY/ UNLIKELY/ REMOTE/ UNCERTAIN)	OVERALL IMPACT SIGNIFICANCE	PROPOSED MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE	OTHER REQUIREMENTS
IMPACT TYPE	SPECIFIC INTERVENTION LEADING TO IMPACT	PROJECT PHASE	RECEPTOR TYPE	SENSITIVITY & RESILIENCE TOWARDS IMPACT	DIRECT/ INDIRECT/ CUMULATIVE	BENEFICIAL/ ADVERSE	SEVERITY	PHYSICAL/ GEOGRAPHIC EXTENT OF IMPACT	SHORT/ MEDIUM/ LONG TERM	TEMPORARY/ PERMANENT	REVERSIBLE/ IRREVERSIBLE					
Loss of rock strata	Excavation	Construction	Mineral resources	Low	Direct and cumulative	Adverse	High	Localised	Long term	Permanent	Irreversible	Inevitable	Moderate	Reuse or recycle excavated waste	Minor	-
Dust dispersion	Excavation and building structure	Construction	Landscape and human health	Low	Direct	Adverse	High	Widespread	Short term	Temporary	Reversible	Likely	Major	Site hoarding, dust suppression techniques, silt traps, etc.	Minor	There should be no stocked material that could be washed away by run-off during the rainy season
Stability of construction pit	Building structure	Construction and Operation	Operatives and third parties' property	High	Direct	Adverse	High	Localised	Long term	Temporary	Reversible	Uncertain	Moderate	Monitor closely during excavation and stabilize if necessary. Silt traps to improve sediment control	Negligible	Monitoring structure settlements by competent geologist or geotechnical engineer
Spillages	Incident during transportation or storage of hazardous substances	Construction	Geological strata, soils, and watercourses	High	Direct	Adverse	High	Widespread	Long term	Temporary	Reversible	Likely	Major	Spill kits, hazardous substance storage areas, bunding systems, oil-water interceptors.	Minor	An emergency plan should be followed
GHG emissions	Storage of waste prior to incineration	Operation	Geological strata, soils, and watercourses	High	Direct	Adverse	Medium	Widespread	Long term	Temporary	Reversible	Likely	Major	Cold storage rooms for waste containers, combustion air	Negligible	-

IMPACT TYPE AND SOURCE			IMPACT RECEPTOR		EFFECT AND SCALE							PROBABILITY OF IMPACT OCCURRING (INEVITABLE/ LIKELY/ UNLIKELY/ REMOTE/ UNCERTAIN)	OVERALL IMPACT SIGNIFICANCE	PROPOSED MITIGATION MEASURES	RESIDUAL IMPACT SIGNIFICANCE	OTHER REQUIREMENTS
IMPACT TYPE	SPECIFIC INTERVENTION LEADING TO IMPACT	PROJECT PHASE	RECEPTOR TYPE	SENSITIVITY & RESILIENCE TOWARDS IMPACT	DIRECT/ INDIRECT/ CUMULATIVE	BENEFICIAL/ ADVERSE	SEVERITY	PHYSICAL/ GEOGRAPHIC EXTENT OF IMPACT	SHORT/ MEDIUM/ LONG TERM	TEMPORARY/ PERMANENT	REVERSIBLE/ IRREVERSIBLE					
														drawn from feeding areas under slight vacuum, shredder housed in a closed room kept under slight negative pressure.		
Other forms of air emissions	Incineration of waste	Operation	Geological strata, soils, and watercourses	High	Direct	Adverse	Medium	Widespread	Long term	Temporary	Reversible	Likely	Major	Installation of emissions abatement systems. Maintenance & training programmes should be regular. Cover vehicles during transport and handling of wastes.	Negligible	-
Deposition of materials on soil	Incineration of waste	Operation	Agricultural field	High	Cumulative	Adverse	High	Immediate surroundings	Long Term	Permanent	Reversible	Remote	Negligible	Monitoring of the pollutants levels around the Scheme	Negligible	-
Ground contamination by liquids and liquid waste	Accidental release of leachate or wastewater	Operation	Geological strata, soils, and watercourses	High	Direct	Adverse	High	Widespread	Short term	Temporary	Reversible	Unlikely	Moderate	Management of wastewater & potential leachate from storage are incorporated within the design and SOPs of the facility	Negligible	N/A

APPENDIX I

ERA TERMS OF REFERENCE

3.0 A DESCRIPTION OF THE SITE AND ITS SURROUNDINGS (I.E. ENVIRONMENTAL BASELINE)

The existing environmental features, characteristics and conditions, in and around the proposed development site as well as in all locations likely to be affected by the development or by ancillary interventions and operations, are to be identified and described in sufficient detail, with particular attention to the aspects elaborated further in the next sections.

The consultants should also identify (and justify) wherever relevant:

- 1. The geographic area (e.g. viewshed or other area of influence) that needs to be covered by each study;*
- 2. The relevant sensitive receptors vis-à-vis the environmental parameter under consideration (e.g. residential communities, other users, natural ecosystems, specific populations of particular species, or individual physical features);*
- 3. The location of the reference points or stations (e.g. viewpoints, monitoring stations, or sampling points (including depth of multiple sampling points at a single sampling point in the case of water media and sediment, where applicable) to be used in the study; and*
- 4. Other methodological parameters of relevance, also noting that the assessment will normally require both desk-top studies and on-site investigations (including visual observations and sampling, as relevant).*

Note: It is recommended that these details are discussed in advance with the ERA prior to commencement of the relevant parts of the studies, in order to pre-empt (as much as possible) later-stage issues.

Wherever relevant to the environmental aspects under discussion, reference to legislation, policies, plans (including programmes and strategies) standards and targets, should also be made, such that the compatibility (or otherwise) of the proposal therewith is also factored into the assessment required by Section 4 below. The discussion should cover the following aspects, in the appropriate level of detail:

- 1. Supra-national (e.g. European Union; United Nations; or other international or regional) legislation, directives, policies, conventions, protocols, treaties, charters, plans and obligations;*
- 2. National legislation, policies and plans (e.g. Structure Plan; National Environment Policy); and*
- 3. Sub-national legislation, policies and plans (e.g. local plans, site-specific regulations, action plans, management plans, and protective designations such as scheduling or Natura 2000).*

Note: In addition to already in-force legislation, policies and plans, the discussion should also cover any foreseeable future updates (or new legislation, policies and plans) likely to be fulfilled, affected or compromised by the proposed project. Furthermore, it should be noted that some cross-cutting legal/policy instruments (e.g. Water Framework Directive and Marine Strategy Framework Directive) may need to be factored into more than one aspect of the discussion.

3.3 Geology, Geomorphology, Hydrogeology, and Soils

A comprehensive investigation of:

- 1. The geology and geomorphology of the site and its surroundings, including:*
 - (i) existing geology, stratigraphy, structure, lithology, physiography and geomorphology features;*
 - (ii) palaeontological features;*
 - (iii) hydrogeological features; and*
 - (iv) soil types.*

Each feature shall be listed in a table, together with a short description and if any of the features are absent, this shall be stated. A scaled map, clearly depicting the feature occurrence within the area of influence, shall also be provided.

- 2. The geo-technical properties and considerations relevant to the site and its area of influence, including:*
 - (i) land stability;*
 - (ii) mechanical, erosional and structural properties of the terrain and land mass;*
 - (iii) any relevant fissures, faults, hollows, or weak points;*
 - (iv) the vulnerability of the site to natural forces such as wave action, erosive elements, landslides and mass movements; and*
 - (v) any other considerations affecting the implications and risks posed by the proposed development or by any of its ancillary interventions such as site clearance, earth-moving, and excavations.*

Each of the above shall be listed in a table along with a short description and if any of the features are absent, this shall be stated. A scaled map, clearly depicting the feature occurrence within the area of influence, shall also be provided.

- 3. The quality of the material that will be excavated (including soil, rock/mineral resource, and any existing fill material) and its potential for reuse.*
- 4. Sampling and testing should comply with the relevant standards (unless otherwise agreed, BS standards or other recognised equivalents should be used), and should extend to a sufficient depth below the deepest level of the proposed development (taking into consideration all proposed excavations and underground structures). Wherever the study involves the drilling of core samples, the number, depth and location thereof should also be submitted for ERA approval prior to carrying out of any in situ tests.*
- 5. A method statement for land and groundwater testing in line with the ERA's 'Terms of Reference for site clearance and land contamination investigations' in Appendix 2 shall be submitted.*

The method statement is part of the baseline report pursuant to the Industrial Emissions (Integrated Pollution Prevention and Control) Regulations and in accordance with the European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions 2014/C 136/03 which is to be submitted to ERA. Such a baseline is to be carried out prior to start of operations.

4.0 ASSESSMENT OF ENVIRONMENTAL IMPACTS AND ENVIRONMENTAL RISKS

All likely significant effects and risks posed by the proposed project on the environment during all relevant phases (including construction/excavation/demolition, operation and decommissioning) should be assessed in detail, taking into account the information emerging from Sections 1, 2 and 3 above. Apart from considering the project on its own merits (i.e. if taken in isolation), the assessment should also take into account the wider surrounding context and should consider the limitations and effects that the surrounding environmental constraints, features and dynamics may exert on the proposed development, thereby identifying any incompatibilities, conflicts, interferences or other relevant implications that may arise if the project is implemented.

In this regard, the assessment should address the following aspects, as applicable for any category of effects or for the overall evaluation of environmental impact, addressing the worst-case scenario wherever relevant:

- 1. An exhaustive identification and description of the envisaged impacts;*
- 2. The magnitude, severity and significance of the impacts;*
- 3. The geographical extent/range and physical distribution of the impacts, in relation to: site coverage; the features located in the site surroundings; whether the impacts are short-, medium- or long-range; and any transboundary impacts (i.e. impacts affecting other countries);*
- 4. The timing and duration of the impacts (whether the impact is temporary or permanent; short-, medium- or long-term; and reasonable quantification of timeframes);*
- 5. Whether the impacts are reversible or irreversible (including the degree of reversibility in practice and a clear identification of any conditions, assumptions and pre-requisites for reversibility);*
- 6. A comprehensive coverage of direct, indirect, secondary and cumulative impacts, including:*
 - interactions (e.g. summative, synergistic, antagonistic, and vicious-cycle effects) between impacts;*
 - interactions or interference with natural or anthropogenic processes and dynamics;*
 - cumulation of the project and its effects with other past, present or reasonably foreseeable developments, activities and land uses and with other relevant baseline situations; and*
 - wider impacts and environmental implications arising from consequent demands, implications and commitments associated with the project (including: displacement of existing uses; new or increased*

pressures on the environment in the surroundings of the project, including pressures which may be exacerbated by the proposal but of which effects may go beyond the area of influence; and impacts of any additional interventions likely to be triggered or necessitated by situations created, induced or exacerbated by the project);

- 7. Whether the impacts are adverse, neutral or beneficial;*
- 8. The sensitivity and resilience of resources, environmental features and receptors vis-à-vis the impacts;*
- 9. Implications and conflicts vis-à-vis environmentally-relevant plans, policies and regulations;*
- 10. The probability of the impacts occurring; and*
- 11. The techniques, methods, calculations and assumptions used in the analyses and predictions, and the confidence level/limits and uncertainties vis-à-vis impact prediction.*

The impacts that need to be addressed are detailed further in the sub-sections below.

5.0 REQUIRED MEASURES, IDENTIFICATION OF RESIDUAL IMPACTS, AND MONITORING PROGRAMMES

5.1 Mitigation Measures

A clear identification and explanation of the measures envisaged to prevent, eliminate, reduce or offset (as relevant) the identified significant adverse effects of the project during all relevant phases including construction, operation and decommissioning [see Section 1.2.3 above].

As a general rule, mitigation measures for construction-phase impacts should be packaged as a holistic Construction Management Plan (CMP). Whilst the detailed workings of the CMP may need to be devised at a later stage (e.g. after the final design of the project has been approved and/or after a contractor has been appointed), the key parameters that the CMP must adhere to for proper mitigation need to be identified in the EIA. Broadly similar considerations also apply vis-à-vis operational-phase impacts [which may need to be mitigated through an operational permit] and decommissioning-phase impacts [see Section 5.4 below], where relevant.

Mitigation measures for accident/risk scenarios should be packaged as a holistic plan that includes the integration of failsafe systems into the project design as well as well-defined contingency measures.

The recommended measures should be feasible, realistically implementable to the required standards and in a timely manner, effective and reliable, and reasonably exhaustive. They should not be dependent on factors that are beyond the developer's and ERA's control or which would be difficult to monitor, implement or enforce. The actual scope for, and feasibility of, effective prevention or mitigation should also be clearly indicated, also identifying all potentially important pre-requisites, conditionalities and side-effects.

5.2 Residual Impacts

Any residual impacts [i.e. impacts that cannot be effectively mitigated, or can only be partly mitigated, or which are expected to remain or recur again following exhaustive implementation of mitigation measures] should also be clearly identified.

5.3 Additional Measures

Compensatory measures (i.e. measures intended to offset, in whole or in part, the residual impacts) should also be identified, as reasonably relevant. Such measures should be not considered as an acceptable substitute to impact avoidance or mitigation.

If the assessment also identifies beneficial impacts on the environment, measures to maximise the environmental benefit should also be identified.

In both instances, the same practical considerations as indicated vis-à-vis mitigation measures should also apply.

5.4 Decommissioning Plan

A decommissioning plan (DP) should also be proposed to address the following circumstances, as relevant:

- 1. Removal of any temporary or defined-lifetime development (or of any structures, infrastructure or land use required temporarily in connection with it) upon the expiry of their permitted duration; and*
- 2. Removal of the development (or of any secondary developments, infrastructure or land use ancillary to it) in the event of redundancy, cessation of operations, serious default from critical mitigation measures, or other overriding situations that may emerge in future.*

The DP should also include, as relevant, a phasing-out plan, proposals for site remediation or decontamination, and methodological guidance on site reinstatement or appropriate after-use.

5.5 Monitoring Programme

A realistic and enforceable programme for effective monitoring of those works envisaged to have an adverse or uncertain impact. The monitoring programme should include:

- 1. Details regarding type and frequency of monitoring and reporting, including spot checks;*
- 2. The parameters that will be monitored, their units of measurement, the monitoring indicators to be used; and standard analytical methods in line with relevant EU policy;*
- 3. An effective indication of the required action to address any exceedances, risks, mitigation failures or non-compliances for each monitoring parameter;*
- 3. An evaluation of forecasts, predictions and measures identified in the EIA; and*

4. *An indication of the nature and extent of any additional investigations (including EIAs or ad hoc detailed investigations, if relevant) that may be required in the event of any contingencies, unanticipated impacts, or impacts of larger magnitude or extent than predicted.*

The programme should address all relevant stages, as follows:

- a. *Where relevant, monitoring of preliminary on-site investigations that may entail significant disturbance or damage to site features (e.g. archaeological excavations, geological sampling, or any works that require prior site clearance or any significant destructive sampling); [Note: Official written consent from the competent authorities (e.g. Superintendence of Cultural Heritage) may also be required for such interventions.]*
- b. *Monitoring of the construction phase, including the situation before initiation of works (including site clearance), during appropriate stages of progress, and after completion of works;*
- c. *Monitoring of the operational phase, except where otherwise directed by ERA (e.g. where monitoring would be more appropriately integrated into an operating permit); and*
- d. *Where relevant, monitoring of the decommissioning phase, including the situation before initiation of works, during appropriate stages of progress, and after completion of works.*

5.6 Identification of required authorisations

The assessment should also identify all environmentally-relevant permits, licences, clearances and authorisations (other than the development permit to which this EIA is ancillary) which must be obtained by the applicant in order to effectively implement the project if development permission is granted. Any uncertainty, as to whether any of these pre-requisites is applicable to the project, should be clearly stated.

Note on Sections 5.1 to 5.6 above:

The expected effects, the proposed measures, the residual impacts, the proposed monitoring etc. should also be summarised in a user-friendly itemised table that enables the reader to easily relate the various aspects to each other. An indicative specimen table is attached in Appendix 5 – attached to Method Statement as Appendix 1.

TERMS OF REFERENCE FOR SITE CLEARANCE AND LAND CONTAMINATION INVESTIGATIONS (VERSION 6; NOVEMBER 2021)

The following terms of reference have been compiled on the basis of BS 10175:2011+A2:2017

In view of the current state of the site and activities carried out to date which could potentially have led to land and groundwater contamination, clearance of the site and preliminary investigations for contamination are required. The documents detailed in the terms of reference below are to be approved by ERA prior to the commencement of any works on site. Malta Resources Authority (MRA) and Energy

and Water Agency (EWA) shall also be notified of the activities on site so they will be able to take any action from their end that they may deem necessary. Should the site bear any legal restrictions / protections, consultation should be carried out with the relevant authorities.

1. Land and groundwater investigations

A proposal for land and groundwater investigations is to be submitted, prepared by experts in the field upon consultation with MRA and EWA (in relation to groundwater), which should include a chemist and/or a hydro geologist, with at least three years' experience in designing land and groundwater monitoring proposals and assessing land and groundwater contamination. Collection of samples should also be carried out by suitably qualified / certified persons familiar with the required methods.

[...]

The proposal for land and groundwater investigations is to include the following:

- a. An overview of the site history including details on the activities carried out (such as illegal dumping and incineration of wastes) and the type of wastes that have been deposited on site and that could have led to land contamination. If information is not available, expert judgment should be used regarding assumptions on the type of activities and wastes associated with such sites and directly associated contaminants.*
- b. A conceptual site model (CSM) is to be developed indicating:

 - i. Which areas have been used for the different activities (known / assumed);*
 - ii. Which areas could have been potentially contaminated by said activities (clearly indicating the sources of contamination identified through the site history, related information and/or assumptions on activities and materials handled / deposited / incinerated), and*
 - iii. The extent of areas that could have been affected through the different potential pathways of contamination identified; this needs to take into consideration sub-surface soils, groundwater and surface waters, potentially contaminated through direct exposure, leaching and run off, within and outside the site.*
 - iv. The ecology, geology, hydrogeology and topography of the site and surrounding area shall be taken into account during the development of the CSM.*
 - v. The proximity of the site to other potential sources of contamination that could have an impact on the site.**
- c. A risk assessment evaluating the environmental setting of the site and identifying any sensitive receptors that may be impacted by potential contamination present within the site.*
- d. Provide rationale / justification for the area of influence proposed for the preliminary investigation, and the number, location and depths of sampling points, making reference to the CSM. It should be noted that the number of sampling points should be statistically representative for the area under investigation, and ensure adequate coverage of the site as well as the greater area of influence (in line with requirements in Table 12 below). In view that groundwater could potentially have been contaminated; sampling of groundwater also needs to be included, preferably making use of existing boreholes. Consultation with the MRA and EWA is required in this regard.*
- e. Based on the CSM developed, sampling locations shall be set to target locations being of a known or suspected source of contamination (ex. existing*

tanks, waste storage areas etc.) or observed environmental impact. Sampling locations may be set to target potential migration routes of mobile contaminants from such sources. The authority may instruct the person to carry out sampling from specific points in the case where reasonable suspicion persists on potential land contamination. Should defined sources of contamination as described above not be identified by the CSM, the sampling locations proposed are to be evenly distributed to cover the entirety of the site.

- f. The following table is an indication of the expected sampling effort. Sampling locations shall not be set at a distance greater than 50m from each other. This may require modification based upon the CSM developed.

TABLE 12: SAMPLING REQUIREMENTS PER AREA OF INVESTIGATION.

Site (square m ²)	LAND	GROUNDWATER	
	DRILLING / TRENCHES	DRILLING WELLS	SAMPLING
< 5,000	At least 2 points	At least 1 point	n. 1 samples per point
5,000 – 10,000	At least 5 points	At least 3 points	n. 1 samples per point
10,000 – 50,000	From 5 to 15 points	From 4 to 6 points	n. 1 samples per point
50,000 – 250,000	From 15 to 60 points	From 6 to 10 points (subject to a risk analysis)	n. 1 samples per point

- g. Samples from various depths are to be taken from each sampling location identified. The first sample is to be within 0.5m from the surface, subsequent sampling depths are to be set at intervals of 1m. The extent of investigation for each sampling location is to be:
- A minimum depth of 4m
OR
 - Until the target depth has been reached if this extends beyond the boundaries set in (i) above.
OR
 - Until proposed excavation depth is reached
OR
 - A different geological stratum has been encountered.
- h. Provide information on sampling procedure to be followed including:
- The drilling/coring equipment to be used;
 - Any in-situ testing that may be required (ex. PIF / FID)
 - Methods to be followed during sampling to ensure cross-contamination does not occur and that samples are handled/stored appropriately until delivery to the lab for testing;
 - Proposed method for backfilling of voids left by extraction of cores including the use of appropriate impermeable compounds such as bentonite.

It should be noted that dry-drilling is recommended to avoid flushing and dispersion of the contaminants which may be present

- i. Provide rationale / justification for contaminants selected for analysis of land and groundwater samples based on the site history and CSM developed. Consultants are to provide a list of contaminants to be investigated in this regards. Proposed omission of analytes is to be duly justified. The assessment should consider analysis for:

- Heavy metals
- Total organic carbon (TOC)
- Hydrocarbons
- BTEX
- Dioxins & furans
- Cyanide
- Fluoride
- MTBE
- PAHs
- PCBs
- Chlorinated aliphatic hydrocarbons
- Halogenated aliphatic hydrocarbons
- Asbestos

ERA may request testing for additional contaminants other than those proposed depending on the results obtained during the works on site as well as following consultation with MRA and EWA.

- j. EPA, ISO, EN or equivalent standards to be used to test for the different contaminants shall be provided, together with the detection limits. Certification of the laboratory/ies chosen for testing is to be provided; Laboratory is to be accredited to at least EN ISO 17025:2005/Cor 1:2006 and accredited for each and every analysis.*
- k. Sample containers are to be sealable and of the appropriate material so as not to cause contamination of the sample, absorb any sample components nor allow losses of volatile compounds. Routinely, wide-mouth amber glass containers are used for analyses of non-volatile organic compounds and PET containers for water-soluble analyses. Containers with a pierceable-septum screw cap can be used to allow for head space analysis for VOCs as required. Any container pretreatment is to be specified. The use of appropriate containers is to be determined in conjunction with the instructions provided by the analyzing lab.*
- l. Collected samples are to be maintained at 4°C - 8°C and retained in darkness at all times up to delivery to the analyzing lab. Samples collected from land are to be maintained under such conditions upon immediate retrieval from the ground and dispatched for analysis at the earliest. Samples to be kept for long-term storage pending further testing shall be maintained at -20°C.*
- m. Drilling logs and photographs are to be taken of the collected cores in their entirety and presented in the final report.*
- n. Locations of core samples are to be confirmed with the Authority on-site prior to initiation of works.*
- o. The results of the investigation and their interpretation are to be presented in a report which includes:*
 - i. Description of ground conditions encountered at the site, including groundwater regime and surface water features*
 - ii. Cross-sections showing site strata and shallow and deep groundwater levels*
 - iii. Summary tables of chemical analyses and site monitoring*
 - iv. Description of type, nature and spatial distribution of contamination, with plans where appropriate*
 - v. Statistical analysis of the data set and derivation of representative concentrations for individual contaminants to a suitable level of statistical significance*
 - vi. Evaluation of site investigation results against the outline conceptual model p.*
- p. Further to (o), presentation of the raw data is to be included as an Annex to the report including:*
 - i. Plans showing monitoring and sample point locations including the GPS coordinates*

- ii. *Description of site works and on-site observations*
- iii. *Exploratory borehole (where applicable), core or drilling logs including the GPS coordinates (UTM WGS 84).*
- iv. *Details of response zone and other construction details of borehole monitoring installations*
- v. *Monitoring results*
- vi. *Description of samples submitted for analysis*
- vii. *Relevant Quality Assurance/Quality Control (QA/QC) data – this may include accreditations of staff, calibration certificates of equipment, laboratory accreditations (national and international standards)*
- viii. *Laboratory analytical reports, completed in accordance with the relevant QA/QC data, including relevant*
- ix. *international analytical or test method standards*

2. Clearance of the site

Method Statement is to be submitted outlining how clearance of the site shall be carried out, including:

- a. *Details of when site is planned to be cleared.*
- b. *How all wastes shall be identified and separated according to the different waste streams as per European Waste Catalogue (EWC) codes defined in Commission Decision 2000/532/EC. A list of these wastes and projected quantities is to be included.*
- c. *How all wastes shall be characterised according to the hazard properties (HP) codes as per The Waste Regulations - S.L. 549.63, Schedule 3.*
- d. *Indicate disposal facilities for all wastes stream identified on site. In this regard it should be noted that: i.*
 - i. *All wastes leaving the site after storage and/or processing must only be sent to facilities licensed to accept the individual waste stream, either locally or abroad.*
 - ii. *Only registered waste carriers as per activity 38 of Schedule 1 in S.L. 549.45 - Waste Management (Activity Registration) Regulations, 2007 are allowed to transport waste to and from this site.*
 - iii. *The applicant shall keep records for every consignment of wastes removed from the site indicating the EWC Code, description, quantities, date of removal, contractor name (including for transport), consignment note number (where applicable) and manner and place of final disposal/recovery. Such records will need to be submitted as part of the final report submitted to ERA for approval documenting the site clearance.*
- iv. *Contaminated excavated material are to be managed and disposed of as waste.*
- v. *Wastes identified as inert are to be tested if suspected to be contaminated by other deposited material.*
- vi. *Should any of the excavated material from the contaminated land be destined for disposal in a landfill, in addition to the abovementioned characterisation analysis, leaching tests should be carried out according to the Waste Acceptance Criteria set out in Council Decision 2003/33/EC.*
- vii. *Should any of the excavated material from the contaminated land be destined for disposal at sea, testing for additional parameters may be requested in addition to the abovementioned characterisation analysis, in line with ERA's Terms of Reference for the Management and Disposal of Dredged Material.*

3. Way Forward following site clearance and land/groundwater investigations

Action may be required by ERA depending on the levels and location of contamination found. The requirement for remediation will depend on the eventual associated risk to human health and the environment from any contamination of land and groundwater, which would need to be assessed following a preliminary screening of the results obtained from the preliminary investigations.

The engagement of experts for further investigations/assessments and proposals for land decontamination and remediation may be required following the preliminary assessment of contamination. Consultation with MRA will also be required in the event of risks to groundwater.