GHALLIS & ZWEJRA NON-HAZARDOUS LANDFILLS

MALTA NORTH WASTE TREATMENT PLANT

CONSOLIDATED ENVIRONMENTAL MONITORING PROGRAMME

Version 7: October 2022

Report Reference:

Adi Associates Environmental Consultants Ltd, 2022. Ghallis & Zwejra Non-Hazardous Landfills, Malta North Waste Treatment Plant. Environmental Monitoring Programme. San Gwann, October 2022; vi + 71 pp. + 4 Appendices.

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Quality Assurance

Ghallis & Zwejra Non-Hazardous Landfills, Malta North Waste Treatment Plant Environmental Monitoring Programme
September 2022

Report for: **WasteServ Malta Ltd**

Revision Schedule

Rev	Date	Details	Written by:	Checked by:	Approved by:
02	Oct 2019	Revision following ERA & EWA feedback	**Rachel Decelis**	**Rachel Xuereb** Director	**Adrian Mallia** Managing Director
03	July 2020	Revision following ERA feedback	**Rachel Decelis**	**Rachel Xuereb**	**Adrian Mallia**
04	Nov 2020	Final revisions	**Rachel Decelis**	**Rachel Xuereb**	**Adrian Mallia**
05	Oct 2021	Updates to meteorology section	**Rachel Decelis**	**Rachel Xuereb** Director	**Adrian Mallia** Managing Director
06	May 2022	Updates to monitoring requirements	**Cinthya Ribero** Env Consultant	**Rachel Xuereb** Director	**Adrian Mallia** Managing Director
07	Oct2022	Revision following client feedback	**Cinthya Ribero** Env Consultant	**Rachel Xuereb** Director	**Adrian Mallia** Managing Director

File ref: G:_Active Projects\Environmental Management Services\Environmental Monitoring\WSM032 - update the EMP for the landfills of Ghallis and Zwejra\Environmental Monitoring Programme - v7_after client revision_2.docx

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1. INTRODUCTION

1.1. This Environmental Monitoring Programme describes the proposed environmental monitoring for the IPPC facilities located within the Maghtab Environmental Complex. The location of these facilities is shown in **Figure 1.1**.

1.2. The operational facilities forming part of the Complex are regulated through Integrated Pollution Prevention and Control (IPPC) permits issued by the Environment and Resources Authority (ERA), or updated versions as may be issued from time to time:

- Ghallis non-hazardous landfill: permitted by IP 0001/06/C;
- Zwejra non-hazardous landfill: permitted by IP 0001/05/C; and
- Malta North Waste Treatment Plant (MNWTP): permitted by IP 0003/19.

1.3. For the purposes of this document, these IPPC facilities are hereinafter referred to as the 'Scheme'. The Scheme is operated by Wasteserv Malta Ltd, hereinafter referred to as 'the Operator'.

1.4. This Environmental Monitoring Programme (EMP) updates and integrates the previously approved monitoring programmes for the Ghallis[1] and Zwejra[2] landfills, to take into account:

- The data obtained as part of the previous monitoring programmes;
- The operation of the MNWTP and the requirements of this facility's IPPC permit; and
- The requirements of relevant updated legislation and guidance.

1.5. The Operator will endeavour to use EN/ISO standards for monitoring, or their equivalent. Laboratories used for analysis will be accredited to at least ISO/IEC 17025:2017.

1.6. Typical limits of detection are included in the monitoring programme where available. In cases where limits of detection are not currently available, the Operator will communicate them to ERA as part of the reporting for such monitoring.

[1] Adi Associates Environmental Consultants Ltd, 2014. *Non-Hazardous Engineered Waste Landfill at Ghallis. Environmental Monitoring Programme required by IPPC permit IP 0001/06/B*. San Gwann, December 2014; vii + 61 pp.

[2] Adi Associates Environmental Consultants Ltd, 2014. *Non-Hazardous Engineered Waste Landfill at Ta' Zwejra. Environmental Monitoring Programme required by IPPC permit IP 0001/05/B*. San Gwann, December 2014; vii + 63 pp.

Figure 1.1: Location of the Scheme

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Location of site

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 8 / 2018

2. THE SCHEME AND ITS SURROUNDINGS

2.1. The Scheme, its surroundings and the background conditions are described in detail in the following documents:

- Ghallis non-hazardous landfill: in the Environmental Impact Assessment (EIA) prepared on behalf of WasteServ by SLR Limited[3];
- Zwejra non-hazardous landfill: in the hydrogeological risk assessment[4] prepared on behalf of WasteServ in support of the IPPC application and the above EIA for Ghallis; and
- Malta North Waste Treatment Plant: in the IPPC application[5] prepared for the facility and in the baseline land and groundwater monitoring report[6].

2.2. Key points only are described here to facilitate an understanding of the conditions and rationale behind the proposed monitoring programme.

OVERVIEW OF THE SCHEME

Zwejra and Ghallis Non-Hazardous Landfills

2.3. Ta' Zwejra engineered landfill was opened for the disposal of non-hazardous waste following the closure of the Maghtab dump in 2004. Much of the landfill has reached full capacity.

2.4. The Ghallis engineered landfill has been operational since 2006 and is used for the disposal of non-hazardous wastes generated in Malta. The facility operates seven days a week.

2.5. Ancillary landfill facilities include a Combined Heat and Power (CHP) Plant, Reverse Osmosis (RO) Plant, and a Regenerative Thermal Oxidiser (RTO).

Malta North Waste Treatment Plant

2.6. The MNWTP started operations in 2016, and comprises a Mechanical Treatment Plant (MTP), Anaerobic Digestion (AD) plant treating Municipal Solid Waste (MSW), bulky waste, and a material recovery facility (MRF) line. The location of the plant is shown in **Figure 1.1**; the MTP is located in the identified area to the west, and is

[3] SLR Ltd (2005) Ghallis – EIA Version 01.
[4] SLR Ltd *Ta' Zwejra Non-hazardous Landfill Facility Hydrogeological Risk Assessment*.
[5] WasteServ Malta Ltd (2021) Integrated Pollution and Prevention Control Consolidated Application: Malta North Waste Treatment Plant (IP003/19): Renewal application of IP 0007/13/A https://era.org.mt/wp-content/uploads/2019/11/WasteServ-Malta-North-Waste-Treatment-PlantConsolidated-Application-for-Renewal-of-IPPC-permit-IP-0007-13-A.pdf
[6] Adi Associates Environmental Consultants Ltd, 2022. Malta North Waste Treatment Plant. Baseline Land & Groundwater Monitoring Report. San Gwann, September 2022; iv + 36 pp.

connected by pipeline to the AD plant on the eastern side.

2.7. The process includes treatment of the MSW and bulky waste in the MTP (including shredding of the bulky waste, and mechanical sorting of the MSW and bulky waste), followed by wetting of the processed MSW, and anaerobic digestion of this fraction.

2.8. An air treatment system is in place, based on scrubbers and biofilters. Wastewater from the digestion process is treated in an aerobic wastewater pre-treatment plant prior to removal from site for discharge into the sewerage network.

2.9. The biogas generated during digestion is stored in a gas bubble, treated and combusted in one of two combined heat and power (CHP) plant on site. The facility also has two emergency electricity generators (one for the MTP and one for the AD plant), and one stand-by boiler (used only for start-up of the anaerobic digesters when the CHP plant is not available).

2.10. A MRF installation for grey bag treatment (recyclables) will be operating at the AD site.

GEOGRAPHICAL SETTING

2.11. The Scheme is located on the northeast coast of the island of Malta, within the Naxxar Local Council Administrative Area. The Naxxar Urban Area is located approximately 1.5 km (plan distance) to the south of the Maghtab Environmental Complex; the nearest settlements are Salini, located approximately 740 m (plan distance) to the northwest, and Bahar-ic-Caghaq, located approximately 890 m to the southeast.

2.12. The Scheme is adjacent to a former non-engineered landfill, the Maghtab dump, which also forms part of the Maghtab Environmental Complex, and which was in operation from 1977[7] to 2004[8]. The Maghtab dump used to accept all of Malta's wastes (including hazardous waste[9]) and was not engineered. It is noted that the Maghtab dump is excluded from the scope of this monitoring programme.

GEOLOGY

2.13. The strata at the site and surrounding area are dominated by detrital limestones comprising the Miocene Globigerina Limestone, underlain by the Oligocene Lower Coralline Limestone. There is limited drift cover.

2.14. The geological strata are approximately horizontally bedded with a gentle regional dip to the north at between 2° and 3°. In the Ghallis EIA it is concluded that discontinuities (fractures and joints) and solution type (karst) features are present

[7] Environment Protection Department *State of the Environment Report 1998*.
[8] MEPA *The Environment Report 2008*.
[9] The SOER, for instance, mentions lead-acid batteries, electro-plating slurries, and iron and metal from the Drydocks.

within the limestone bedrock below the site, inferred from partial or complete loss of drilling fluid returns at various depths during drilling of boreholes.

2.15. An east-west trending fault, down thrown to the north, may be present entering the western side of Ghallis landfill[10]. Minor faults are known to be common in this area of Malta and are reported to comprise a conjugate set with a general north-south and east-west orientation.

HYDROGEOLOGY

2.16. The primary aquifer below the site is developed within the Lower Coralline Limestone Formation and is represented by a thin freshwater lens that overlies brackish/saline groundwater. This is the 'Mean Sea Level Aquifer', as the groundwater elevations lie just above sea level.

2.17. Groundwater in the Lower Coralline Limestone Formation beneath the Ghallis and Zwejra landfills is shown in the SLR EIA and Drawing RA5 to the Ghallis IPPC permit application as approximately 1m above mean sea level to the south of the site at the access, falling gently to the north to approximately 0.25 m beneath the northern part of the Ghallis landfill (approximately 0.5 m to the north of the Ta' Zwejra site).

2.18. As the minimum basal elevation of the Ghallis landfill (Phases 2, 3 and 4) will lie at approximately 16 m above sea level, and a minimum unsaturated zone thickness of approximately 15 m is anticipated. For Zwejra, as the minimum basal elevation of the proposed landfill lies at approximately 30 m above sea level, a minimum unsaturated zone thickness of approximately 30 m is anticipated.

2.19. Primary hydraulic conductivity in the range 2.4×10^{-10} to 2.27×10^{-6}m/s and secondary hydraulic conductivity in the range 2.0×10^{-4} to 1.5×10^{-3}m/s are suggested in the Ghallis EIA.

HYDROLOGY

2.20. The Maltese Islands' climate is a typical Mediterranean one with mild wet winters and hot, dry summers. Precipitation is in the form of rain, hail, dew and soft rime. The average precipitation rate calculated over 30 years (1961-2010) is that of 553.12 mm with a standard deviation of 156.99 mm (28.38 co-efficient of variation) (NSO 2011). The wettest month is typically December, with an average rainfall of 93.7 mm. The driest month is July with an average monthly rainfall of only 0.57 mm. The majority of rainfall takes place between October and March with approximately 85% of the average annual precipitation falling during this part of the year. During April to September, however, rainfall may be significant, with maximum recorded monthly rainfalls for August and September of between 155 mm and 235 mm respectively. Rainfall events are typically characterised by single storms of relatively short duration.

[10] Oil Exploration Directorate, Office of the Prime Minister (1993). Geological Map of the Maltese Islands, Sheet 1, Malta.

This often results in runoff taking place over a short period, during and immediately following the storm event.

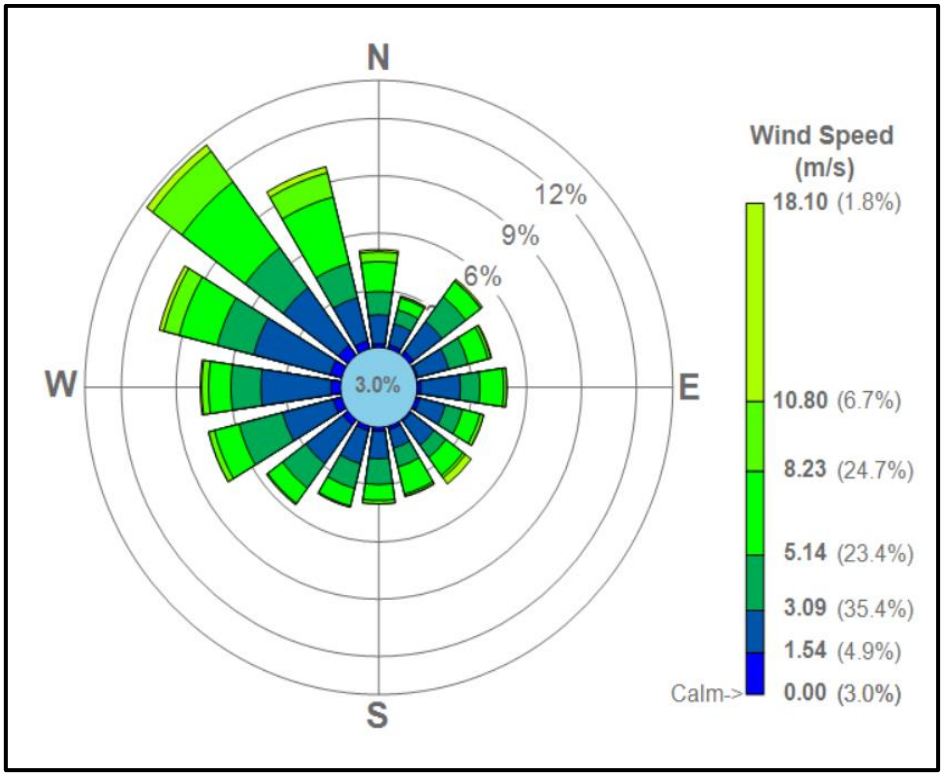
2.21. There are no permanent surface water features within the sites or adjacent surrounding area, reflecting the small catchment size, climatic conditions and the hydraulic conductivity of the underlying limestones.

2.22. The design criteria for surface water runoff from the landfill cap are described in the EIA and Hydrogeological Risk Assessment, and include peripheral infiltrating drainage ditches (swales) and soakaways to be located on the perimeter of the sites. For Ghallis, the approximate total capacity required for the swales to accommodate the most intense 24-hour storm recorded over the period 1985 to 2004 and assuming an infiltration rate of 500 mm/h is calculated by SLR Ltd at 13,500 m^3. SLR calculated that this total volume could be achieved using ditches of approximate dimensions 1m deep, 1m bed with side slopes of 1 in 4. The proposed surface water management plan is shown on Drawing AL(2-)08A. For Zwejra, the swales have been designed with a capacity to attenuate runoff from the facility during 1:100 year rainfall events.

WIND SPEED AND DIRECTION

2.23. Prevailing winds blow from the northwest sector for 30% of the time and include the Majjistral and Punent. Winds from the north, northeast, southeast and southwest sectors occur infrequently and calm conditions (wind speeds less than 0.5 m/s) occur for approximately 3% of the time. The wind rose for the year 2017 is presented in **Figure 2.1**; data is from the Malta International Airport in Luqa.

Figure 2.1: Wind rose



3. METEOROLOGY

CURRENT MONITORING PRACTICE

3.1. Meteorological data is measured at the site office of the Zwejra landfill. The parameters measured are:

- Rainfall;
- Temperature;
- Wind speed and direction;
- Humidity; and
- Pressure.

3.2. Measurements are made on an hourly basis.

3.3. Evaporation has also been measured at times; however, the measurement instrument is subject to frequent breakdown, and so this data is not reported.

MONITORING REQUIREMENTS

3.4. Annex III of the Landfill Directive (1999/31/EC) indicates that if Member States decide that water balances are an effective tool to evaluate whether leachate is building up in the landfill or whether the landfill is leaking, a number of meteorological parameters should be monitored. Monitoring should be carried out daily for precipitation (volume), temperature, wind (speed and direction), evaporation and atmospheric humidity.

MONITORING STRATEGY

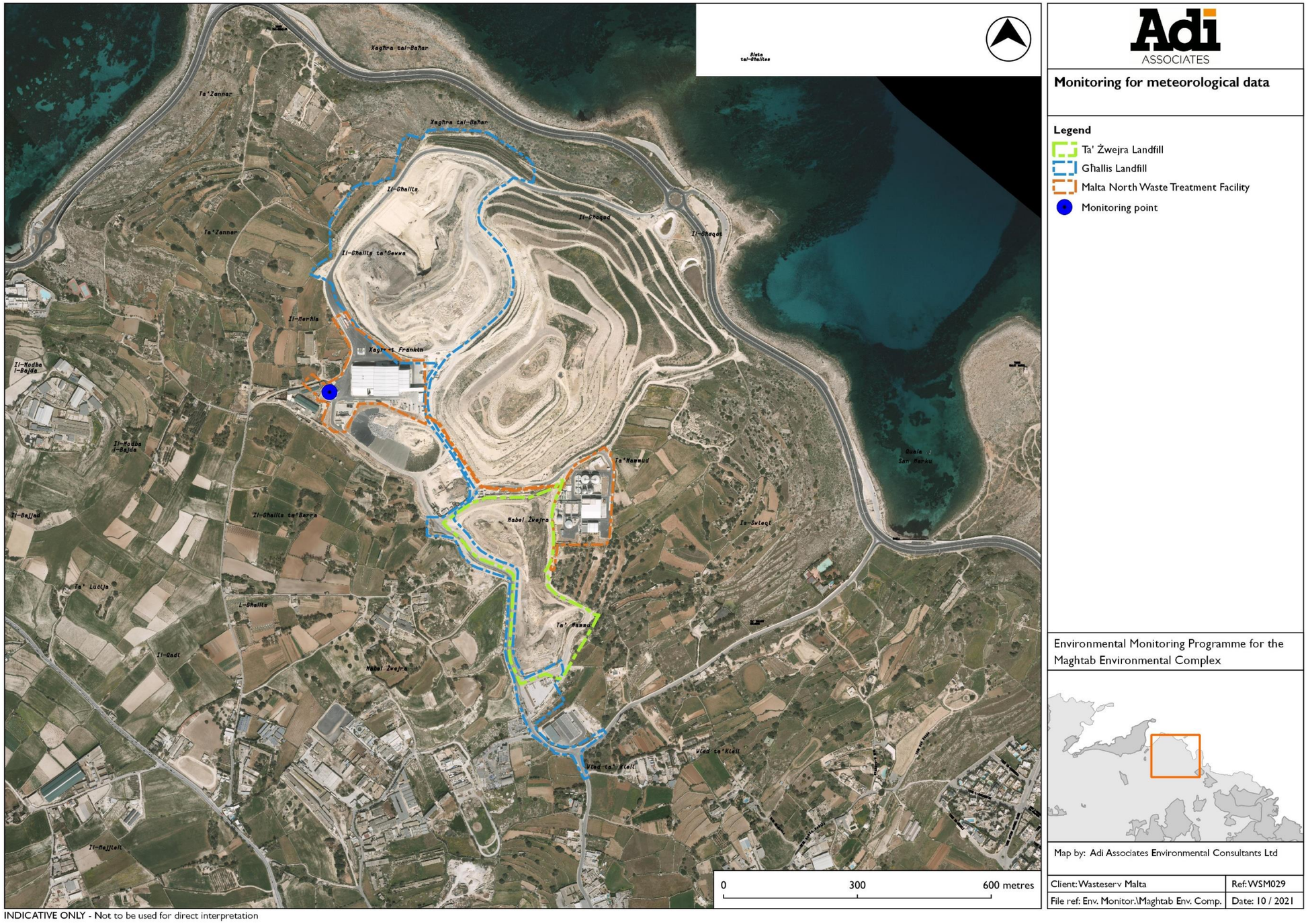
3.5. A new weather station will be installed at a different location to the previous one. The new location is shown in **Figure 3.1**.

3.6. A monitoring plan for the collection of meteorological data is provided in **Table 3.1**. Due to the disadvantages associated with monitoring evaporation using an evaporation pan and gauge, this will be measured by a sensor using the Penman Monteith algorithm.

Table 3.1: Meteorological monitoring

Parameters	Frequency	Instrument type
Precipitation (volume)	Daily	Rain gauge
Temperature	Daily	Temperature probe
Wind (speed and direction)	Daily	Wind speed sensor & wind direction sensor
Evaporation	Daily	Sensor that uses the Penman Monteith algorithm
Atmospheric humidity	Daily	Humidity probe
Atmospheric pressure	Daily	Barometric pressure meter

Figure 3.1: Monitoring location for meteorological data



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Monitoring for meteorological data

Legend

- Ta' Żwejra Landfill
- Għallis Landfill
- Malta North Waste Treatment Facility
- Monitoring point

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
File ref: Env. Monitor.\Maghtab Env. Comp.	Date: 10 / 2021

4. LANDFILL GASES

4.1. This Chapter applies to monitoring from the Ghallis and Zwejra landfills only, which are the sources of landfill gases within the Maghtab Environmental Complex.

MONITORING REQUIREMENTS AND GUIDANCE

4.2. Annex III of the Landfill Directive 1999/31/EC requires monthly measurement of potential gas emissions (CH_4, CO_2, O_2, H_2S, H_2, etc.) and atmospheric pressure for an operational landfill. The monitoring frequency may, however, be revised if the evaluation of data indicates that longer intervals are equally effective. Notably, regular measurement of CH_4, CO_2 and O_2 is a requirement; other gases are to be measured as required, according to the composition of the waste deposited, with a view to reflecting its leaching properties.

4.3. UK guidance[11] identifies that landfill gas monitoring should be carried out as follows[12]:

- Source monitoring from:
    - gas collection wells; and
    - monitoring wells (that are independent of the gas collection and extraction system), where leachate monitoring wells may also be used to support such measurements;
- Emissions monitoring of:
    - lateral emissions, using gas monitoring boreholes outside the perimeter of the deposited waste; and
    - surface emissions from capped areas.

4.4. The monitoring frequencies and parameters to be measured, as recommended in UK guidance, are identified in **Table 4.1** and compared to the current practice.

4.5. Additionally, the Landfill Directive notes that the monitoring interval may be adjusted following an evaluation of the results.

[11] Environment Agency (2004). *LFTGN 03: Guidance on the management of landfill gas*.
[12] Monitoring from combustion plants, ambient air quality monitoring, and meteorological monitoring are also identified in this guidance. These are addressed in other Chapters in this Environmental Monitoring Programme.

Table 4.1: Monitoring recommendations for landfill gases (UK guidance)

Type of monitoring	Monitoring point	Monitoring frequency	Parameters	Current practice at Ghallis & Zwejra landfills
Source monitoring	Gas collection wells	Fortnightly	CH_4, CO_2, O_2 Atmospheric pressure Differential pressure Gas flow rate or suction Temperature	No monitoring is currently carried out from the gas collection wells; however, it is possible to collect landfill gas from the gas wells for analysis in future
Source monitoring	Gas collection system (site-specific), e.g. manifolds	Annually	Composition of raw landfill gas (including trace components) from the extraction line and prior to the disposal system	Currently such a detailed analysis is carried out on gas samples from one leachate monitoring point and one groundwater monitoring borehole (these would, however be dilute samples); it is possible in future to conduct a detailed analysis on samples from the gas wells instead
Source monitoring	Monitoring wells (within the landfill)	Monthly	CH_4, CO_2, O_2 Atmospheric pressure Differential pressure Temperature Meteorological data	Leachate wells within the landfill are used for such monitoring (no other monitoring wells independent of the gas collection and extraction system are installed)
Emissions monitoring of lateral emissions	Monitoring boreholes (external to the landfill)	Monthly	CH_4, CO_2, O_2 Atmospheric pressure Differential pressure Temperature Meteorological data	Groundwater monitoring boreholes external to the landfills are used for this purpose

Type of monitoring	Monitoring point	Monitoring frequency	Parameters	Current practice at Ghallis & Zwejra landfills
Emissions monitoring of surface emissions	(i) Walk over survey (ii) Flux box monitoring	(i) Annually (ii) Site-specific (1-5 years)	Methane concentration / flux Atmospheric pressure and temperature Meteorological data General surface type and condition	(i) Surface emissions are monitored from points 0, 1, 3 and 4 at Ghallis, and LFG4, and 6-8 at Zwejra (monitoring from LFG 1-3, 5, 9 and 11 (at Zwejra) was discontinued); however, to date all areas at the Ghallis and Zwejra landfills are active to some extent, and so this monitoring is not providing useful information. (ii) Flux box monitoring is not carried out as there are no permanently capped areas.

MONITORING STRATEGY

4.6. A consolidated monitoring plan is provided in **Table 4.2**, while monitoring point locations are shown in **Figure 4.1** to **Figure 4.5**. It is noted that the instrumentation available on site does not allow for the measurement of differential pressure and gas flow rate / suction and so these parameters have not been included. However, a monitoring strategy for meteorological parameters (atmospheric pressure, temperature, etc.) is already included in **Chapter 3**, and is therefore not repeated below.

Table 4.2: Landfill gas monitoring

Monitoring location	Measured Parameters	Frequency	Instrument type	Assessment levels
Random sampling of 10% of active gas collection wells, as shown in **Table 4.3** (existing wells are shown in **Figure 4.1** and **Figure 4.2**)	CH_4, CO_2, O_2	Monthly	Portable Infra-Red gas analyser	Not applicable

Monitoring location	Measured Parameters	Frequency	Instrument type	Assessment levels
Main line carrying gas to the CHP / RTO plant[13]	Detailed gas composition and priority trace components[14]	Annually	Portable Infra-Red gas analyser for bulk gases. Alternatively, and for trace components: dual solid sorbent / solid sorbent / reactive sorbent / Gresham tube / Tedlar bag (as appropriate), followed by laboratory analysis	Not applicable
Leachate monitoring points (LCP4-13, Z1-Z6)[15] (**Figure 4.3** and **Figure 4.4**)	CH_4, CO_2, O_2	Quarterly[16]	Portable Infra-Red gas analyser	Not applicable; this data is used to ascertain the composition of landfill gas and how it responds to environmental conditions
Groundwater monitoring boreholes (BH1, BH2, BH4, 3308, 2130)[17] (**Figure 4.5**)	CH_4, CO_2, O_2	Quarterly[16]	Portable Infra-Red gas analyser	**Trigger levels:** 1% CH_4 above background, 1.5% CO_2 above background[18]
Walk over survey on capped areas	CH_4 (concentration) General surface type and condition	Annually	Portable Flame Ionisation Detector (FID) calibrated with CH_4	Immediately above the surface on the main zones of the cap: <100 ppmv Close to any discrete feature (such as a leachate well or wellhead): <1,000 ppmv
Capped areas	CH_4 flux	Annually	Flux box/FID	Permanently capped zone: 0.001 $mg/m^2/s$ Temporarily capped zone: 0.1 $mg/m^2/s$

[13] It is important to ensure that the gas collection system is at or near steady state conditions when the sample is taken. If it is not possible to sample from the main line, two random gas collection wells (one from Ghallis and one from Zwejra) will be sampled instead.
[14] See **Appendix 1**. This list is based on Environment Agency (2010) *LFTGN04: Guidance for monitoring trace components in landfill gas*, also taking into account the results of the previous environmental monitoring programme.
[15] As described in **Chapter 8**, LCP1-LCP3 are closed; leachate monitoring points are added as new landfill cells are added.
[16] The frequency in the previously approved EMP for Ghallis has been retained.
[17] Active / closed groundwater monitoring boreholes are as described in **Chapter 9**.
[18] Background level to be measured in borehole 2130.

4.7. A sampling plan showing the order in which each gas well will be sampled is presented in **Table 4.3**; the sampling plan will be updated as more active gas wells are added.

Table 4.3: Gas wells sampling plan

Month	Gas wells sampled						
	Ghallis				Zwejra		
1	A	4	14	24		H	R
2	B	5	15	25		I	S
3	C	6	16	26		J	T
4	D	7	17		A	K	U
5	E	8	18		B	L	V
6	F	9	19		C	M	W
7	G	10	20		D	N	X
8	I	11	21		E	O	
9	2	12	22		F	P	
10	3	13	23		G	Q	
Month 11 onwards: repeat as per month 1 onwards							

4.8. UK guidance[19,20] indicates that surface emissions monitoring should be carried out in areas of the landfill having a permanent cap, or that are temporarily capped (for longer than 12 months). Therefore, monitoring of surface methane gas emissions is to be done in two stages, as described below. Such monitoring will be carried out when the individual cell is capped; it is noted that to date all areas at the Ghallis and Zwejra landfills are active to some extent and therefore this monitoring will commence at a later stage.

4.9. The first stage of surface emissions monitoring involves carrying out a systematic walkover survey on the landfill cap, to identify areas where methane concentrations are high. This is done using a hand-held gas detector, such as a Flame Ionisation Detector (FID), placed close to the surface of the cap. The purpose of this survey is to identify areas where there are inadequacies in the gas containment and collection system. The survey should be carried out systematically and the concentration of methane in different areas recorded. The results are then assessed against assessment levels in **Table 4.2**. An exceedance of these values indicates a fault in the gas management system, which should be rectified. Monitoring should only proceed to the second stage when these reference values are not exceeded. The walkover survey is to be repeated annually.

4.10. The second stage of monitoring involves carrying out a flux box survey; this is carried out within a year of capping. An exceedance of the assessment levels in **Table 4.2** suggests that remedial work is required.

[19] Environment Agency (2004). *LFTGN 03: Guidance on the management of landfill gas*.
[20] Environment Agency (2010). *LFTGN 07: Guidance on monitoring landfill gas surface emissions*.

CONTINGENCY PLAN

Lateral Emissions (Groundwater Monitoring Boreholes)

4.11. The trigger levels set in UK guidance for off-site gas monitoring boreholes are indicated in **Table 4.4**.

Table 4.4: Trigger levels at off-site gas monitoring boreholes

Parameter	Trigger concentrations (% v/v)
Methane	1% above agreed background concentrations
Carbon dioxide	1.5% above agreed background concentrations

4.12. Trigger levels are compliance levels and, therefore in order to meet them, action levels should be set at a lower level, so that the operator can take action to remain compliant. In the previous monitoring programme, action levels were set at 1% (methane) and 1.5% (carbon dioxide), without deducting background concentrations. However, since background concentrations are very low, it is proposed that lower action levels would be more appropriate.

4.13. The proposed action levels (**Table 4.5**) have been set at 50% of the trigger concentration, disregarding any background contribution (since this has been shown to be negligible).

Table 4.5: Proposed action levels (groundwater monitoring boreholes)

Parameter	Action levels
Methane	0.5% v/v
Carbon dioxide	0.75% v/v

4.14. The following protocol is proposed should the above action levels (indicative of lateral emissions for the landfill) be exceeded:

ii. Increase monitoring of affected and immediately adjacent boreholes to daily;

iii. Check that the gas extraction system in the vicinity of the affected borehole is operating normally; if not, rectify;

iv. Undertake purging of the affected borehole(s) via the gas analyser pump for 15 min, recording gas levels at regular intervals (i.e. not greater than 5 minutes) on the same day the exceedance of the action level is noted;

v. If gas concentrations remain largely unchanged following a 15 minute purge, take gas sample(s) from the affected borehole(s) for laboratory analysis by GC-MS and initiate monitoring in buildings or services within 250 m of affected boreholes using portable FID. If the methane concentrations in any services or property are measured at greater than 5,000 ppm (10% of lower explosive limit) the landfill gas risk will be assessed (receptors, ignition source, etc.). If the methane concentration in services or property exceeds 8,000 ppm (16% LEL) ventilation will be increased in affected confined spaces and

ignition sources isolated. If the methane concentration in any service or property exceeds 10,000 ppm (20% LEL) evacuation procedures will be initiated;

vi. FID monitoring will be repeated once daily when the above action levels are exceeded, and twice daily when the trigger levels are exceeded in any monitoring borehole;

vii. If gas concentrations show a marked decrease following a 15 minute purge (step (iv)) repeat purging for 5 consecutive days. If gas concentrations remain below assessment levels on 5 consecutive days monitoring, revert to normal;

viii. In the event that the result of GC-MS analysis of the sample taken in step (v) is consistent with landfill gas, the gas management system design and operation will be reviewed. If the result is consistent with a non-landfill source of flammable gas or vapours an investigation of source will be initiated; and

ix. All results will be reported to ERA on the day taken.

Figure 4.1: Gas collection wells (Ghallis)

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Gas collection wells - Għallis

Legend

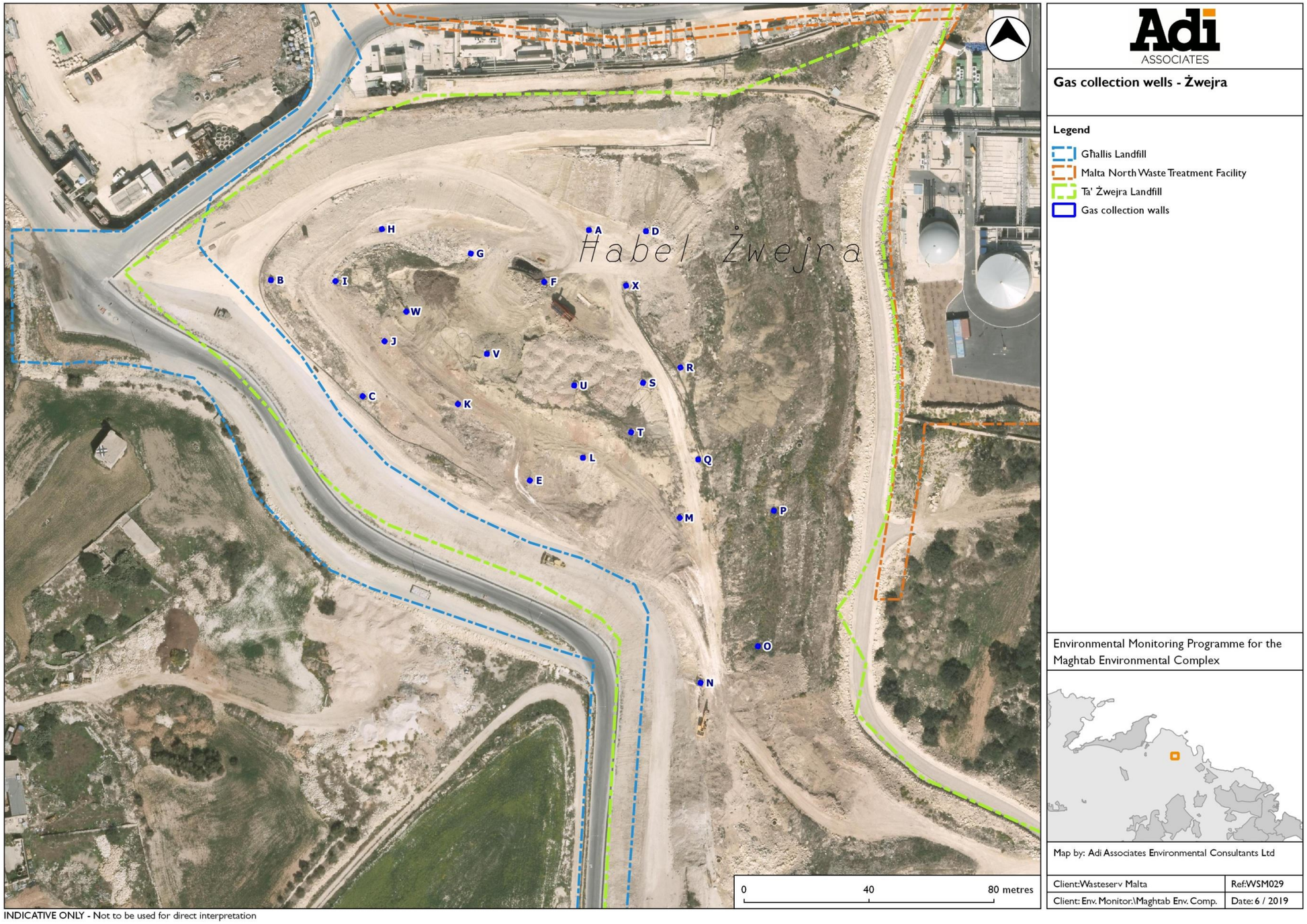
- Għallis Landfill
- Malta North Waste Treatment Facility
- Gas collection walls

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 8 / 2018

Figure 4.2: Gas collection wells (Zwejra)



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Gas collection wells - Żwejra

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
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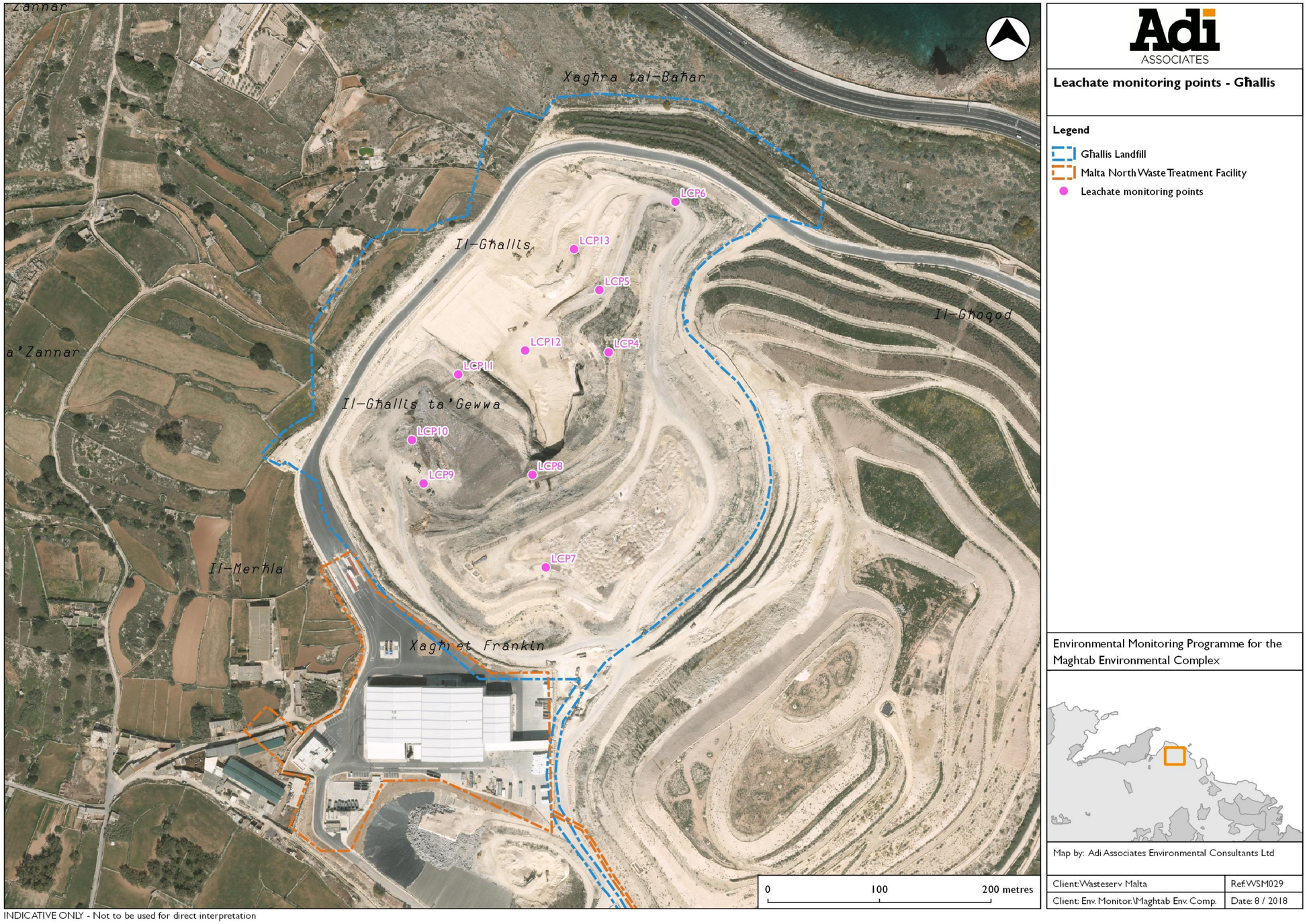
INDICATIVE ONLY - Not to be used for direct interpretation

Figure 4.3: Leachate monitoring points (Ghallis)



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Leachate monitoring points - Għallis

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Leachate monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 8 / 2018

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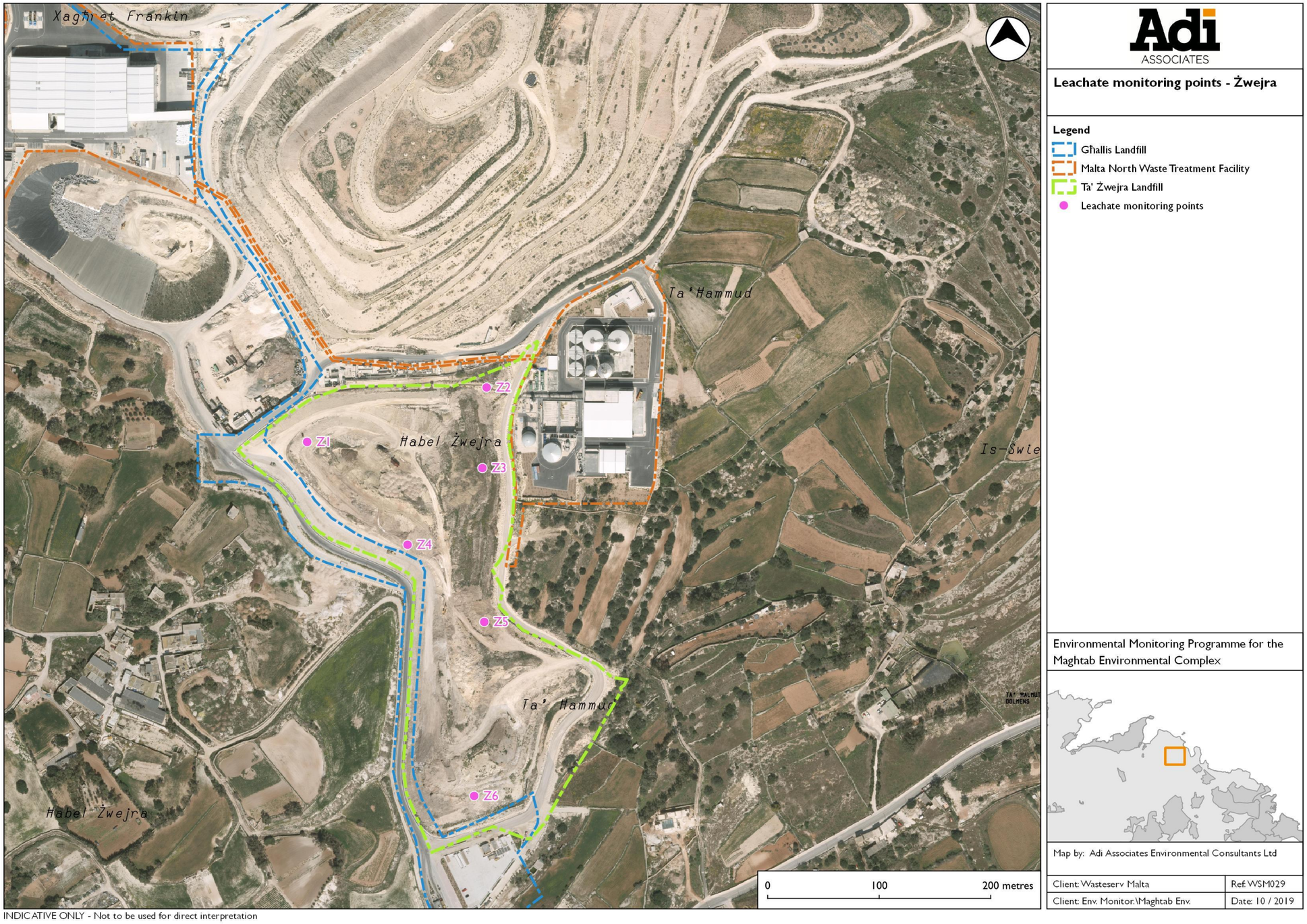
Figure 4.4: Leachate monitoring points (Zwejra)



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Adi ASSOCIATES

Leachate monitoring points - Żwejra

Legend

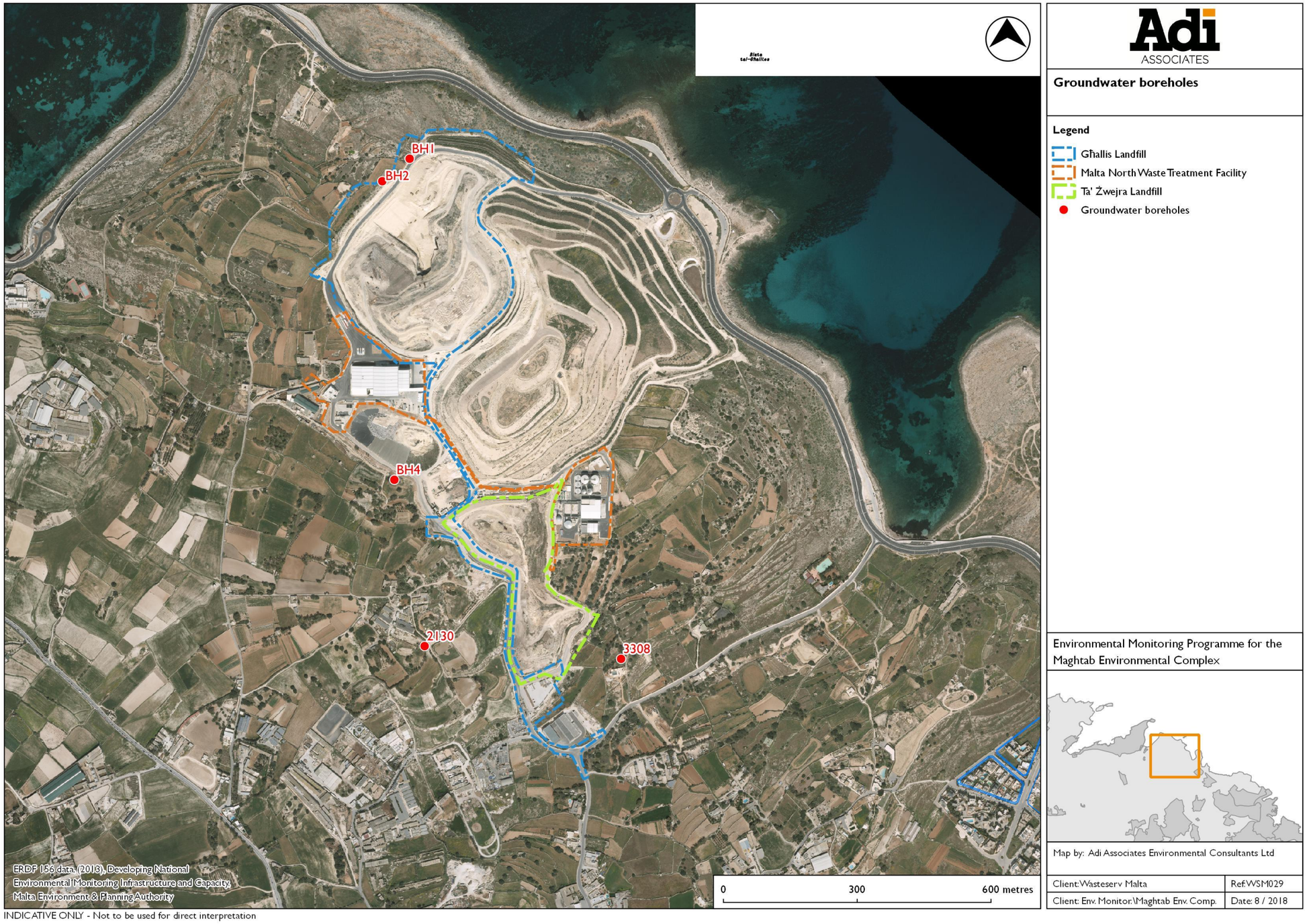
- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- Leachate monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env.	Date: 10 / 2019

Figure 4.5: Groundwater monitoring boreholes



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5. STACK AND DIFFUSE EMISSIONS ON SITE

LANDFILLS

5.1. With regard to the RTO and CHP plant situated at Ghallis and Zwejra, ERA advised[21] that monitoring from the CHP plant is required in accordance with the Limitation of Emissions of Certain Pollutants into the air from Medium Combustion Plants Regulations (S.L. 549.122). Since the CHP plant at Ghallis has a rated thermal input of 0.47 MW, which is lower than the 1 MW threshold above which S.L. 549.122 applies, monitoring from the CHP plant is not required. ERA also advised[21] that monitoring from the RTO is to be limited to Total VOC (TVOC).

5.2. A monitoring plan is provided in **Table 5.1**; the monitoring point is the RTO plant located as shown in **Figure 5.1**.

Table 5.1: Monitoring plan for stack emissions from the RTO plant

Parameter	Frequency	Typical detection limit
TVOC	Annual	0.1 mg/m^3
Flow	Annual	0.1 Nm^3/h
Oxygen[22]	Annual	0.1%
Temperature[22]	Annual	0.1 °C
Moisture[22]	Annual	0.01 mole fraction

5.3. The gas flare is not currently operational, and there are no concrete plans for its future use. Therefore, no monitoring from the flare is recommended at this stage. This recommendation is to be reviewed should the gas flare start to be operated for more than 10% of the year (in accordance with UK guidance[23]).

MALTA NORTH WASTE TREATMENT PLANT

Monitoring Requirements

5.4. The following stack emission points are present on site:

- PS 1: MTP Emergency diesel generator;
- PS 2: AD Emergency diesel generator;
- PS 3: AD emergency flare;
- PS 4: AD CHP station 1;
- PS 5: AD CHP station 2;

[21] Email from Ritianne Stellini Galea (ERA), 8th May 2019.
[22] Parameter measured to enable normalisation of the results.
[23] Environment Agency (2010). *LFTGN 05: Guidance for monitoring enclosed landfill gas flares*.

- PS 6: AD boiler;
- PS 7: MTP biofilter vent;
- PS 8: AD plant biofilter; and
- PS 9: Compost shed & MRF stack.

5.5. It is noted that the emergency flare (PS3) is only used very rarely, when any issues arise with the CHP due to malfunctions or poor quality biogas, in order not to emit any biogas directly to air.

5.6. The BAT-associated emission levels (BAT-AELs) for emissions to air according to Commission Implementing Decision (EU) 2018/1147 of 10 August 2018 establishing best available techniques (BAT) conclusions for waste treatment (**Table 6.7**) are as shown in **Table 5.2** below. The Industrial Emissions (IPPC) Regulations, S.L.549.77, require ERA to set emission limit values that ensure that emissions do not exceed the BAT-AEL; this is required within four years of publication of the Implementing Decision, i.e. by August 2022.

Table 5.2: Minimum monitoring frequency and BAT-AELs for channelled emissions to air from the biological treatment of waste

Parameter	Minimum monitoring frequency	BAT-AEL (Average over the sampling period)[24]	Notes
NH_3 (1) (2)	Once every six months	0.3-20 mg/Nm^3	-
Odour concentration (1) (2)	Once every six months (4)	200-1,000 ou_E/Nm^3	The BAT Conclusions allow monitoring of NH_3 and H_2S instead of odour concentration, although an extensive odour monitoring programme is included in **Chapter 7.**
Dust	Once every six months	2-5 mg/Nm^3	-
TVOC	Once every six months	5-40 mg/Nm^3 (3)	TVOC Monitoring at PS9 (MRF) is not needed to be done since there is no biological treatment of waste and no mechanical treatment using shredders on metal waste

(1) Either the BAT-AEL for NH_3 or the BAT-AEL for the odour concentration applies.

(2) This BAT-AEL does not apply to the treatment of waste mainly composed of manure.

(3) The lower end of the range can be achieved by using thermal oxidation.

(4) The monitoring of NH_3 and H_2S can be used as an alternative to the monitoring of the odour concentration.

[24] Average value of three consecutive measurements of at least 30 minutes each (unless this timing inappropriate).

5.7. It is noted that PS9 (the compost shed) is not a channelled emissions point, therefore, in accordance with the above BAT Conclusions and in agreement with ERA[25] monitoring from this point is not required.

5.8. A part of the compost shed will be closed off to house the MRF line. The stack of the MRF will be monitored as per **Table 5.4**.

5.9. Commission Implementing Decision (EU) 2018/1147 also establishes that monitoring of NH_3, dust and TVOC for channelled emissions from biological treatment activities (i.e. PS7 and PS8) should be carried out every six months; however, considering the activities on site, ERA considers this frequency to be a minimum standard for dust and TVOC.5.9. According to the BAT conclusions, VOC monitoring from the stack is only required when mechanical treatment using shredders of metal waste. Since the MRF facility does not use metal shredders at any stage of the process, and in accordance with the above BAT Conclusions, VOC monitoring from the stack is not required.

5.10. Decision 2018/1147 (BAT 16b) recommends monitoring and recording as part of flare management, including:

- continuous monitoring of the quantity of gas sent to flaring;
- possible estimations of other parameters (e.g. composition of gas flow, heat content, ratio of assistance, velocity, purge gas flow rate, pollutant emissions (e.g. NO_X, CO, hydrocarbons), noise); and
- recording of flaring events, which usually includes the duration and number of events and allows for the quantification of emissions.

5.11. Monitoring from the emergency generators (PS1 and PS2) and the AD boiler (PS6) is not required. It is noted that the generators are only used in case of mains power supply failure, and the AD boiler has only been operated minimally, until the CHP plant started up.

5.12. Additionally, the Limitation of Emissions of Certain Pollutants into the Air from Medium Combustion Plants Regulations (SL 549.122) are applicable to the two CHP engines on site (PS4 and PS5), as they each have a rated thermal input of 1.5 MW_{TH}. The applicable limit values according to these Regulations are as indicated in **Table 5.3**; these limit values are defined at a temperature of 273.15 K, a pressure of 101.3 kPa, after correction for the water vapour content of the waste gases, and a standardised O_2 content of 15%. Monitoring is required every three years for the parameters listed in **Table 5.5**, as well as for CO.

[25] Email from Ritianne Stellini Galea, 8th May 2019.

Table 5.3: Emission limits to air (Medium Combustion Plants Regulations)

Parameter	Limit
SO_2	60 mg/Nm^3
NO_x	190 mg/Nm^3

5.13. ERA has indicated[26] that diffuse monitoring is not required, provided that all the necessary abatement referred to in the IPPC permit is implemented. Therefore, such monitoring is not included in the current EMP.

Monitoring Programme

5.14. A monitoring plan for stack emissions is presented in **Table 5.4**. Such monitoring will be carried out when the respective plant is in regular operation.

Table 5.4: Monitoring plan for MNWTP stack emissions

Emission point reference (Figure 5.2)	Parameter	Typical detection limit	Monitoring frequency
PS7 & PS8	Total VOC (using EN 12619)	0.1 mg/m^3	Monthly
PS7, PS8 & PS9	Total dust (the sampling strategy is based on EN 13284-1: 2017, and described in **Appendix 2**)	<1 mg/Nm^3	Monthly
PS7 & PS8	H_2S	0.3 mg/m^3 [(27)]	Every six months[28]
PS7 & PS8	NH_3	0.15 mg/m^3	Monthly (every 6 months from 2021[28])
PS7 & PS8	Odour (EN 13725, using an accelerator fumehood, as described in **Appendix 2**)	To be advised by the Contractor	Annually (initially) – refer to Chapter 7
PS4 & PS5	Oxides of nitrogen	0.56 mg/Nm^3	Once every three years
PS4 & PS5	Oxides of sulphur	0.56 mg/Nm^3	Once every three years
PS4 & PS5	Carbon monoxide	0.01 mg/Nm^3	Once every three years
PS4 & PS5	Flow	0.1 Nm^3/h	Once every three years
PS4 & PS5	Oxygen[29]	0.1%	Once every three years
PS4 & PS5	Temperature[29]	0.1 °C	Once every three years
PS4 & PS5	Pressure[29]	-	Once every three years
PS4 & PS5	Moisture[29]	0.01 mole fraction	Once every three years

5.15. Monitoring from PS8 will be carried out at the AD biofilter, since this is the relevant channelled emission point from the AD shed.

5.16. Monitoring from the emergency flare (PS3) will only be undertaken if the flare is in regular operation (used more than 10% of the year). If this is the case, a monitoring

[26] Email from Ritianne Stellini Galea, 8th May 2019.
[27] The detection limit could vary with the method; however, it may be possible to reduce the detection limit by taking a longer sample.
[28] As per Commission Implementing Decision 2018/1147.
[29] Parameter measured to enable normalisation of the results.

proposal will be provided to ERA. However, when the flare is used:

- the quantity of gas sent to flaring will be monitored;
- other parameters, such as heat content, ratio of assistance, velocity, and purge gas flow rate will be monitored;
- emissions of pollutants will be estimated using standard emission factors; and
- the date, duration, and number of events will be recorded.

CONTINGENCY PLAN

5.17. In the event of an exceedance of a limit value in the permit, the following procedure will be followed:

- Site management and ERA will be notified as soon as possible;
- The potential cause of the exceedance will be identified (e.g. abnormal operating conditions, overdue maintenance of equipment);
- Potential solutions will be identified and implemented;
- The monitoring will be repeated at the earliest practicable opportunity; and
- The outcome will also be notified to ERA.

Figure 5.1: Stack emissions monitoring point (RTO plant)

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Stack emissions monitoring points - RTO plant

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- RTO plant

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env.	Date: 4 / 2020

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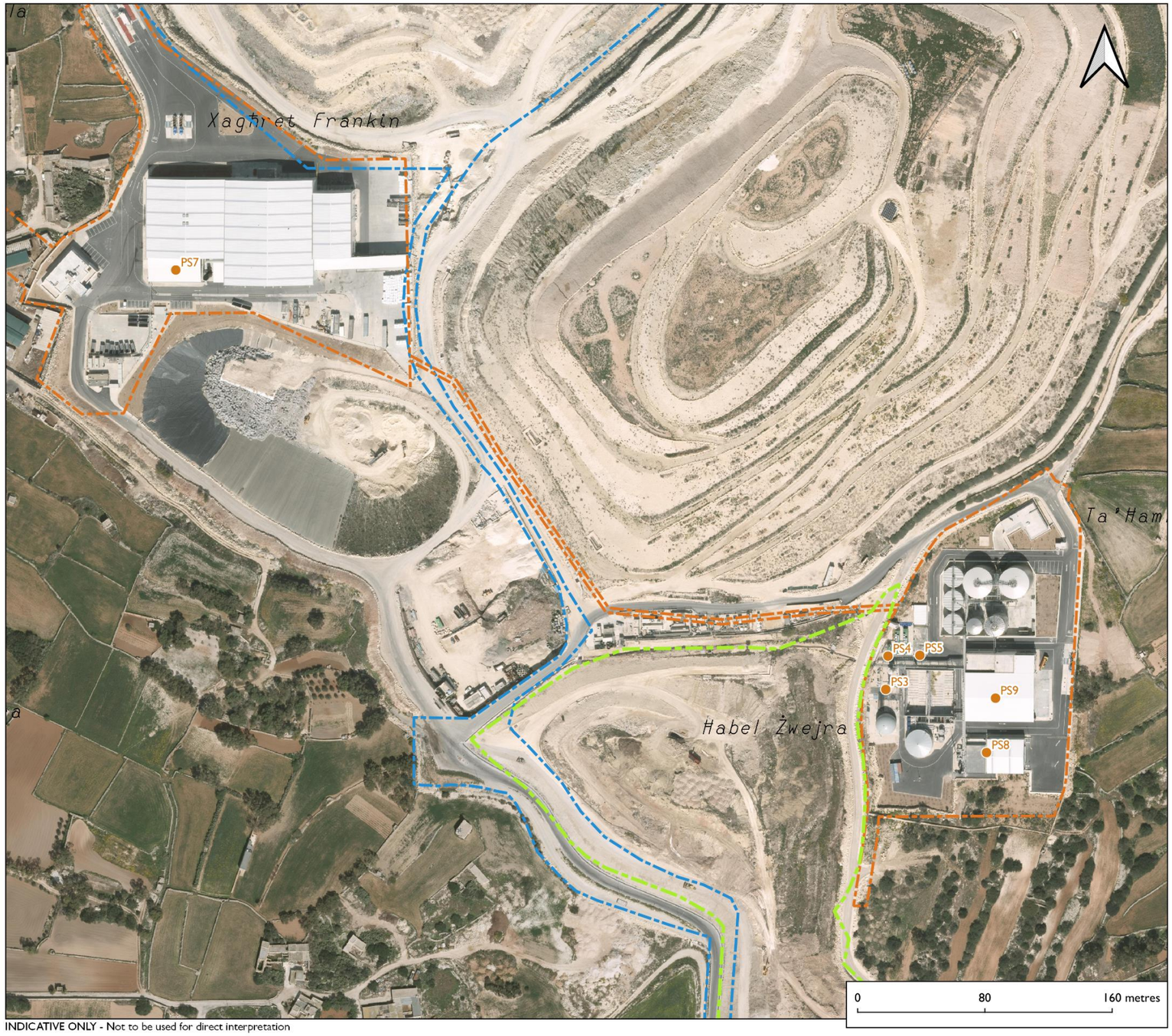
Figure 5.2: Stack emissions monitoring points (MNWTP)



Adi ASSOCIATES

Stack emissions monitoring points

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- Stack emissions monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM032
Client: Env. Monitor.\Maghtab Env.	Date: 5 / 2022

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6. AMBIENT AIR

MONITORING REQUIREMENTS AND GUIDANCE

6.1. UK guidance[30] states that air quality monitoring on landfill sites will typically consist of odour monitoring (which is addressed in **Chapter 7**) and particulate matter monitoring.

6.2. The previously approved ambient air monitoring programme required monitoring of PM_{10}, $PM_{2.5}$, hydrogen sulphide, benzene, toluene, xylene, methane and dioxins, furans (the latter only if gas flaring is carried out), at several off-site monitoring points.

6.3. However, ERA has since provided guidance[31] that the off-site monitoring requirements for ambient air pollutants are not required. ERA also requested that the Operator makes efforts to minimise emissions from the relevant sources to the extent possible, by implementing relevant abatement techniques.

6.4. In light of ERA's updated guidance, the ambient air monitoring programme will be discontinued.

[30] Environment Agency (2004). *LFTGN 03: Guidance on the management of landfill gas*.
[31] Ritianne Stellini Galea (ERA), email dated 21st January 2019.

7. ODOUR

UK GUIDANCE

7.1. UK guidance[32] describes how odour monitoring should be undertaken at a landfill site. As far as possible, odour assessments downwind of the site should start from the furthest point away from the site and move towards the site boundary. Upwind of the site, surveys should move in a proximal to distal direction, i.e. starting at the site boundary and moving further away. The persistence of the odour, together with its location from the site boundary, should be noted.

7.2. The degree of odour pollution is dependent on several factors[33], frequently referred to as FIDOR or FIDOL:

- **F**requency of detection;
- **I**ntensity as perceived;
- **D**uration of exposure;
- **O**ffensiveness; and
- **R**eceptor sensitivity (or **L**ocation).

7.3. It is noted that offensiveness and strength of odours are dependent on factors such as race, gender, age, occupation, health and previous history of odour experiences.

7.4. A more detailed methodology for sniff testing and assessment is described in Institute of Air Quality Management (2018)[34] guidance. This guidance stipulates surveying each monitoring point for five minutes, and recording any odour experienced during this time (using the FIDOL parameters), as well as the prevailing wind direction and average wind speed.

7.5. The results at the sensitive receptors are then assessed using an odour exposure matrix for neutral and unpleasant odours, followed by a matrix that classifies the odour effect at individual receptors according to the receptor sensitivity. Receptors are classified according to their sensitivity, as follows:

- High sensitivity receptors: Land where users can reasonably expect enjoyment of a high level of amenity and be expected to be present continuously or regularly (e.g. residences, schools);
- Medium sensitivity receptors: and where users would expect to enjoy a

[32] Environment Agency (2004). *LFTGN 03: Guidance on the management of landfill gas.*
[33] Environment Agency (2011) *H4 Odour Management.*
[34] Institute of Air Quality Management (2018) *Guidance on the Assessment of Odour for Planning* http://www.iaqm.co.uk/text/guidance/odour-guidance-2014.pdf.

reasonable level of amenity (but not at the same level as in their home), or wouldn't expect to be present here continuously or regularly (e.g. workplaces, commercial / retail premises, playing fields); and

- Low sensitivity receptors: Land where enjoyment of amenity would not reasonably be expected, or where there is transient exposure (e.g. industrial, farms, footpaths and roads).

BEST AVAILABLE TECHNIQUE (BAT) CONCLUSIONS

7.6. In 2018, the European Commission published Commission Implementing Decision (EU) 2018/1147 establishing best available techniques (BAT) conclusions for waste treatment. These BAT conclusions apply to the MNWTP, but not to the landfills.

7.7. These BAT conclusions require periodic monitoring of odour emissions (BAT 10), with the monitoring frequency to be determined in an odour management plan according to BAT 12.

CURRENT PRACTICE

7.8. Current practice is for a routine odour survey to be carried out once daily on weekdays. The survey is carried out by a member of staff who does not work at the operational area (people tend to be become "accustomed" to smell, such that their perception is less acute than that of other people).

7.9. Fixed odour monitoring points are not specified in the approved EMP, as the appropriate location/s for monitoring will depend on the wind direction during the survey.

7.10. The person responsible for routine monitoring determines the wind direction initially from the site meteorological station. The monitor then proceeds to the site boundary upwind of the operational area of the landfill, and notes the strength and characteristics of any odour.

7.11. The monitor proceeds to the landfill boundary downwind of the site and repeats the exercise, moving along the site boundary, such that the 150 m of the boundary downwind and either side of the operational area is traversed.

7.12. The monitoring personnel then moves to the immediate vicinity of the working (waste deposition) area to ascertain whether the wastes comprise a source of significant odour. All observations of odour (frequency, intensity, duration of exposure, offensiveness and location) are recorded.

7.13. It is noted that the current assessment level ('discernible odour') is frequently reached at the landfill boundary, given the nature of the activities. However, this is not necessarily indicative of the impact at odour sensitive receptors and is therefore not a useful assessment level.

7.14. In the case of complaints, methane concentrations downward of the odour can also be measured using a portable Flame Ionising detector (FID) so as to localise the

source of faults in the landfill gas collection system.

7.15. Sniff testing is also conducted at various off-site locations every fortnight.

7.16. The current monitoring protocol is summarised in **Table 7.1.**

Table 7.1: Current odour monitoring protocol

Monitoring location	Measured parameters	Frequency	Instrument type	Assessment levels
Site meteorological station	Wind direction	Daily	Wind vane	Not applicable
Landfill boundary upwind of site	Odour	Daily	Site staff not normally operating at working area	Discernible odour
Landfill boundary downwind of site	Odour	Daily	Site staff not normally operating at working area	Discernible odour
Site downwind of noted odour, moving upwind in accordance with contingency plan	Methane	In case of complaints	FID	Not applicable
Off-site locations	Odour	Fortnightly	Site staff not normally operating at working area	Discernible odour

MONITORING PROGRAMME

7.17. It is considered that the current daily routine odour monitoring method can be retained, as shown in **Table 7.2**. The current odour monitoring locations can be retained, since the landfills, being in the open, are expected to be the largest contributors to odour emissions (compared to the MNWTP). However, it is proposed that the former assessment level will be removed, in favour of a more robust assessment protocol as described in the following paragraphs.

Table 7.2: Proposed daily routine odour monitoring programme

Monitoring location	Measured parameters	Frequency	Instrument type
Site meteorological station	Wind direction	Daily	Wind direction sensor
Boundary upwind of operational area of landfill	Odour	Daily	Site staff not normally operating at working area
Boundary downwind of landfills (150 m either side of the operational area)	Odour	Daily	Site staff not normally operating at working area

7.18. Sniff testing and assessment using the IAQM (2018) method will also start to be carried out monthly, and whenever odour complaints are received. In such instances, sniff testing will normally be carried out by two staff members not based at the Scheme site; however at quarterly intervals testing would be carried out by an

external contractor not based at the Scheme site. The persons carrying out the sniff test are to have a 'normal' sense of smell (i.e. not too sensitive and not nose dead). Additionally, in order to safeguard the quality of the assessment, the assessors will not carry out the survey if they have any respiratory infections, and will avoid wearing perfume or consuming strongly flavoured food or drink (such as coffee) just before the survey.

7.19. The monitoring locations in the case of routine monthly sniff tests are:

- The residential receptors shown in **Figure 7.1** (labelled as 1 and 2);
- A monitoring point along the coast road, as requested by ERA (labelled as 3 in **Figure 7.1**); and
- A point at the landfill site boundary that is downwind of the landfill during the survey.

7.20. In order to avoid olfactory fatigue, the assessors will start with the receptor that is upwind, then carry out the survey at the downwind receptor, and finally at the site boundary.

7.21. In the case of complaints, the monitoring point/s will be at the location/s of the complaint/s, plus a point at the landfill site boundary that is downwind of the landfill during the survey. If waste odours are not detected at the landfill site boundary, a point at the MNWTP site boundary that is downward of the MNWTP will also be surveyed.

7.22. The proposed sniff testing monitoring programme is summarised in **Table 7.3.**

Table 7.3: Proposed sniff testing monitoring programme

Monitoring location	Measured parameters	Frequency	Instrument type
Points 1, 2, 3 (**Figure 7.1**), landfill boundary (downwind)	Odour	Monthly	Two staff members not based at the Scheme site (external contractor used instead at quarterly intervals)
At location of complaint/s, landfill boundary (downwind), if no odours at landfill boundary: MNWTP site boundary (downwind)	Odour	Whenever odour complaints are received	Two staff members not based at the Scheme site

7.23. During the sniff test, each monitoring point will be surveyed for five minutes, and records will be kept of any odours noticed, including their character, frequency, intensity, duration and offensiveness, as well as the prevailing wind direction and average wind speed. An odour wheel may be used to describe odour character. If necessary, the study will focus only on odours of interest (e.g. landfill / waste odours) since certain extraneous odours (e.g. food) would not be relevant to this assessment.

7.24. A scale published by the Institute of Air Quality Management (IAQM, 2018), as

shown in **Table 7.4**, will be used to record odour intensity.

Table 7.4: Odour intensity categories

Odour strength	Intensity level	Description
No odour / not perceptible	0	No odour
Slight / very weak	1	There is probably some doubt as to whether the odour is actually present
Slight / weak	2	The odour is present but cannot be described using precise word or terms
Distinct	3	The odour character is barely recognisable
Strong	4	The odour character is easily recognisable
Very strong	5	The odour is offensive. Exposure to this level would be considered undesirable
Extremely strong	6	The odour is offensive. An instinctive reaction would be to mitigate against further exposure

7.25. The mean odour intensity (I_{mean}) and the percentage odour time $t_I \geq 4$, i.e. the percentage of samples where the odour strength was definitely recognisable by the assessor (therefore having an odour intensity of 4 or more), will first be calculated. IAQM guidance states that when the mean odour intensity is 0, the odour effect can be considered to be negligible; additionally, when the mean odour intensity is 1 but $t_I \geq 4$ is 0%, the odour effect can also be considered to be negligible.

7.26. When the odour levels exceeded these thresholds, the odour effect will be calculated using the odour exposure matrix for neutral and unpleasant odours in **Table 7.5**.

Table 7.5: Odour exposure matrix[35]

Mean odour intensity	Percentage odour time ($t_I \geq 4$)				
	≤10%	11 to 20%	21 to 30%	31 to 40%	≥41%
6	Large	Very large	Very large	Very large	Very large
5	Medium	Large	Large	Very large	Very large
4	Small	Medium	Medium	Large	Large
3	Small	Medium	Medium	Medium	Medium
2	Small	Small	Medium	Medium	Medium
1	Small	Small	Small	NA	NA

7.27. The odour exposure obtained from the above matrix will then be used to assess odour impact by using a matrix that classifies the odour effect at individual receptors according to the receptor sensitivity (**Table 7.6**).

[35] IAQM (2018). This matrix applies to neutral and unpleasant odours.

Table 7.6: Matrix to assess the odour effect at receptors[36]

Overall odour exposure	Receptor sensitivity		
	Low	Medium	High
Very large	Substantial adverse	Substantial adverse	Substantial adverse
Large	Moderate adverse	Moderate adverse	Substantial adverse
Medium	Slight adverse	Slight adverse	Moderate adverse
Small	Negligible	Negligible	Slight adverse

7.28. Additionally, in accordance with Waste Treatment BAT Conclusions, odour emissions monitoring will be carried out at PS7, PS8, and PS9, as shown in **Figure 7.2**. Monitoring will be carried out in accordance with EN 13725 in order to determine the odour concentration; sampling will be carried out using an accelerator fume hood, as described in **Appendix 2** . A Method Statement for such monitoring will be prepared for ERA's consideration by the Contractor awarded the monitoring. Initially, such monitoring will be carried out annually; however, the monitoring frequency will be confirmed in an odour management plan for the MNWTP (which will be drawn up within 9 to 12 months from approval of this EMP).

CONTINGENCY PLAN

7.29. The following protocol is proposed should the odour effect at the odour sensitive receptors be found to be slightly adverse or worse (either through the monthly survey or following a complaint):

- Analyse the odour character and wind direction and confirm whether the landfills (or MNWTP) are causing the odour effect.
- Identify the wind direction from the data provided by the site meteorological station. This will give a broad indication of wind direction, but not necessarily reflect localised conditions, which may vary as a result of surface topography, particularly the Maghtab landfill.
- At the point on the landfill boundary where the odour is noted, or the nearest point on the boundary upwind of any complaint, measure the methane concentration using a Flame Ionising Detector (FID). Move, as far as practically, perpendicular to the wind direction, noting the methane concentration in air measured at approximately 1m from ground surface. Identify the point at which the methane concentration is greatest.
- From the point of maximum methane concentration identified in the previous step, determine the wind direction using a hand-held pennant or burgee and move upwind, again measuring the methane concentration by FID. Mark the

[36] IAQM (2018). It is noted that this matrix is not prescriptive.

point at which the methane concentration is greatest using a simple marker such as a cane. It may be necessary to repeat the traverse several times to identify the area of maximum concentration.

- Repeat the determination of the wind direction and traverse, as far as practical, to left and right perpendicular to the wind direction noting the methane concentration. Identify the point at which the methane concentration is greatest. This should bring the operator in proximity to the source of the landfill gas (and odour) source.

- If the source of landfill gas / odour is not immediately apparent, such as fractured landfill gas pipes, gas well headworks, etc., further localised monitoring at ground level using the FID should be used to pinpoint the source.

- If the source is from the ground rather than above ground infrastructure (pipes, headworks, etc.), excavation may be necessary to locate below ground gas control infrastructure to identify damage. If the source is spread over a relatively large area, it may be indicative of active methane production and inadequate gas extraction and appropriate measures should be taken, such as the addition of cover, re-balancing of the gas extraction system or installation of additional gas extraction wells.

- If the MNWTP is identified as the potential odour source, a review of site operations will be held to determine what could be causing the odour (e.g. faulty odour abatement measures, incorrect waste storage practices), and corrective measures will be implemented.

- Once the required corrective measures have been implemented the odour survey will be repeated.

Figure 7.1: Odour monitoring points (receptors)

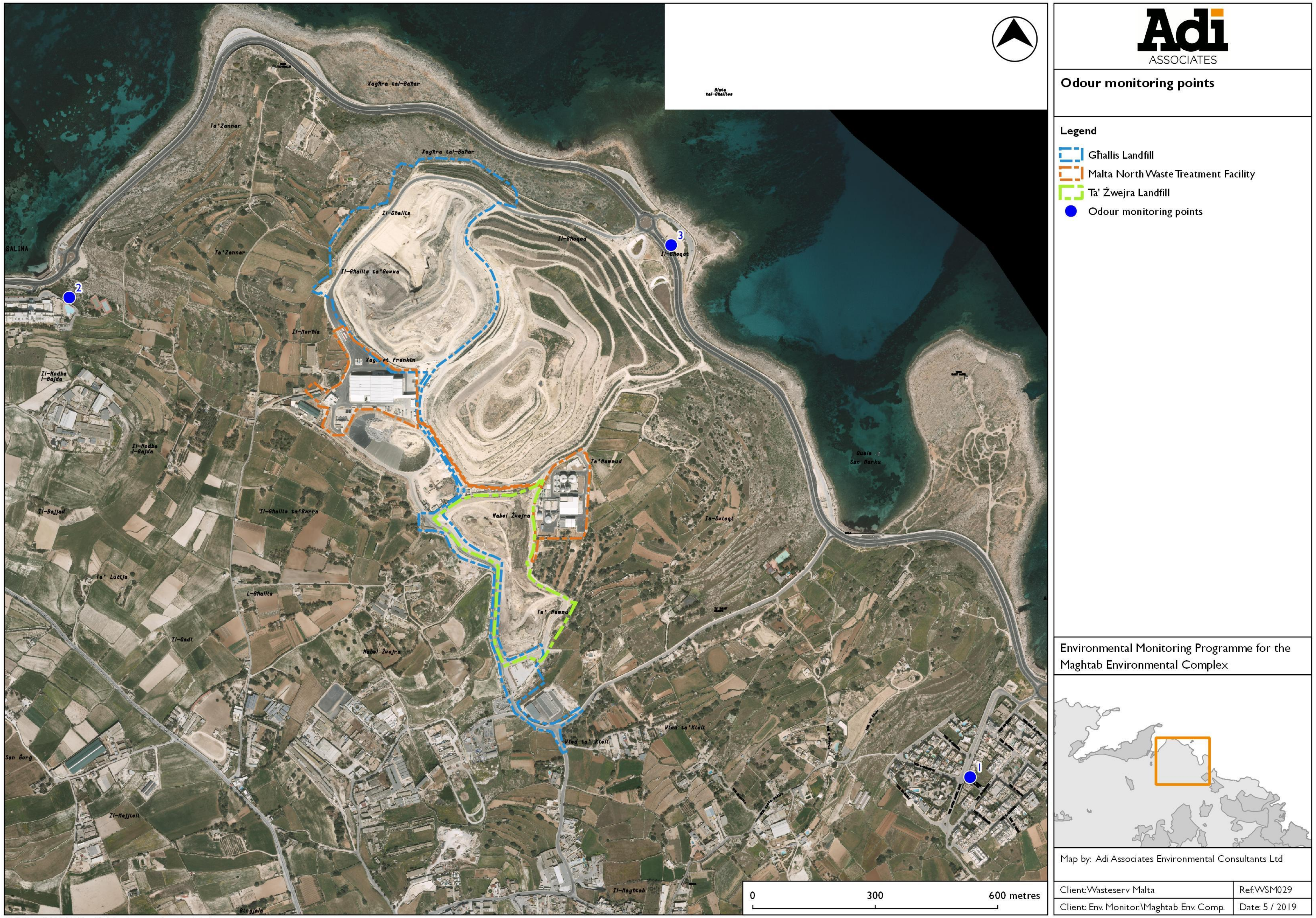

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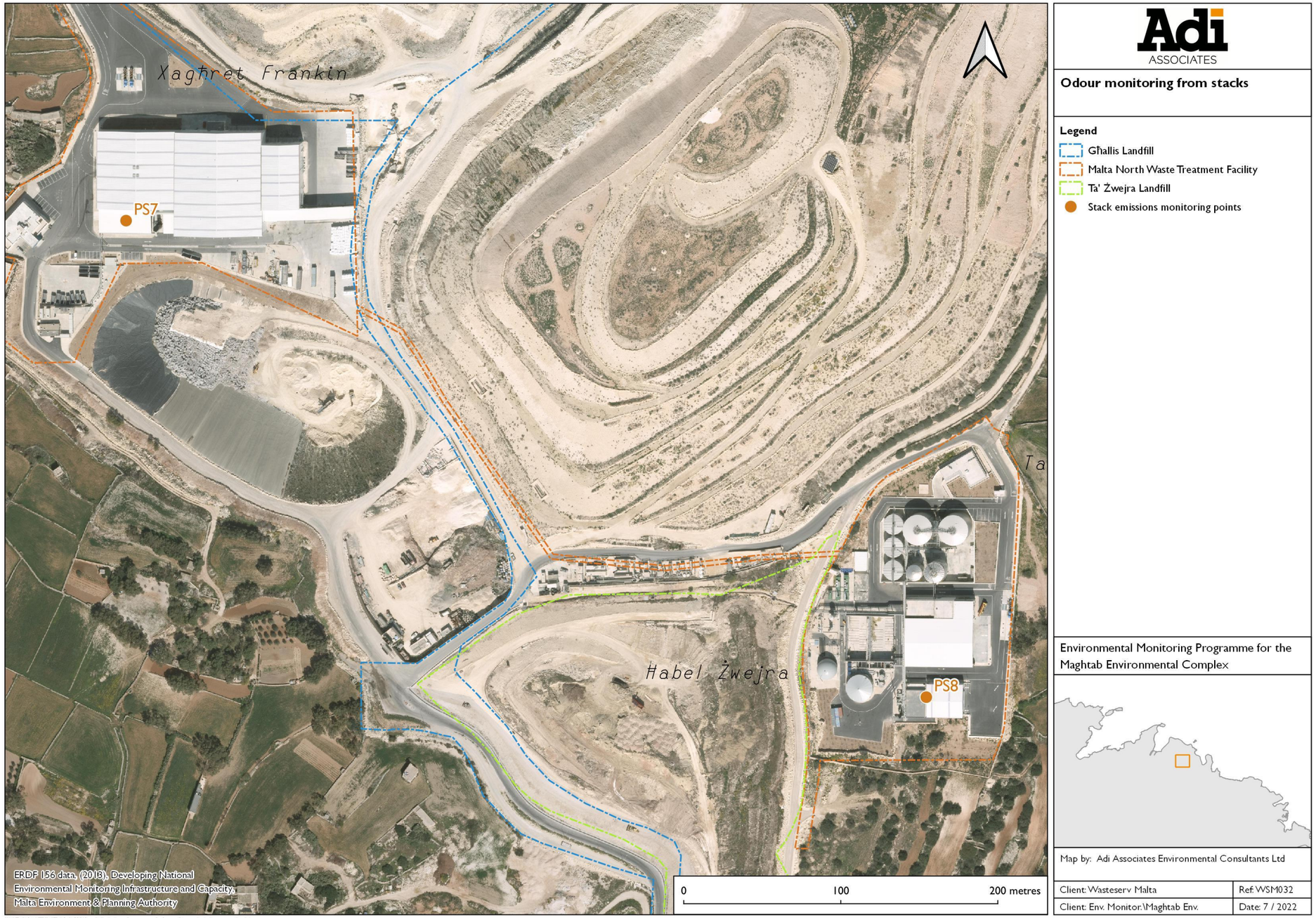
Figure 7.2: Odour monitoring points (stack emissions)



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8. LEACHATE

8.1. This Chapter applies to the Ghallis and Zwejra landfills, which are sources of leachate.

UK GUIDANCE

8.2. The Environment Agency issued guidance on monitoring leachate, groundwater and surface water in 2003[37] to take into account the Landfill Directive. This guidance introduced a risk-based monitoring review and describes characterisation monitoring, indicator monitoring, assessment monitoring and completion monitoring.

8.3. The primary purpose of initial characterisation monitoring is to minimise ambiguity in the interpretation of data following commencement of landfill operations. All initial characterisation monitoring measurements should be repeated at least annually within the sequence of routine monitoring programmes to provide a screening check.

8.4. Indicator monitoring allows the use of a selected number of determinants and measurements, based on the characteristics of each water body revealed by initial characterisation monitoring. The selection of indicator measurements and monitoring frequencies should be based on knowledge gained from a risk-based monitoring review and from the interpretation of initial characterisation monitoring results. Ongoing characterisation measurements are a periodic repeat of the same measurements carried out during the initial characterisation monitoring, but at a lower frequency that for the indicator parameters.

8.5. Assessment monitoring is triggered when it becomes apparent that a potential impact from the landfill is occurring. The specification of assessment monitoring schedules should be based on a re-evaluation of the risk using all available relevant monitoring data.

8.6. The last stage in the monitoring programme is completion monitoring, carried out to demonstrate that the site is no longer capable of harming human health or the environment. The results of leachate and landfill gas monitoring demonstrate that the site still represents a significant source of contaminants, therefore, completion monitoring is not considered further here.

8.7. Example schedules are also given in the Guidance, but reflect the change in emphasis to risk-based monitoring. A risk-based approach should supersede reliance on model or example monitoring guidance. Example schedules should not be considered obligatory. Table 6.2 to the Guidance suggests that, for a biodegradable site posing moderate to high risk to groundwater receptors, two leachate level monitoring points per 5 ha cell should be provided in addition to leachate extraction points. The current leachate monitoring regime conforms to that suggested. Table 6.5 to the

[37] Environment Agency (2003) *LFTGN02: Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water.*

Guidance provides an example of principal chemical composition measurements, but does point out that for all parameters, analyses should be determined on site-specific conditions or for assessment purposes. The monitoring programme proposed in Appendix 3 to the Site Management System includes many of the parameters included in Table 6.5 to the Guidance, with the addition of naphthalene and toluene, which were identified as List 1 substances for modelling in the Hydrogeological Risk Assessment carried out as part of the IPPC Permit application process. However, no differentiation was made between characterisation monitoring and indicator monitoring.

8.8. The Guidance states that for many non-hazardous biodegradable landfills, initial characterisation monitoring could reasonably be undertaken monthly for physical measurements such as leachate levels, and six-monthly for chemical composition measurements.

8.9. The Guidance discusses the use of control and trigger levels and describes how trigger levels have a role both as a performance standard for monitoring and as the success criteria for the risk assessment. The selection of substances should reflect this dual role. The important principle is to select the minimum number of substances that are representative of the compounds present (or predicted to be present) within the leachate. The minimum considered necessary here is that chosen in the Hydrogeological Risk Assessment. However, naphthalene and toluene were replaced with hydrocarbons in the former approved EMP (since this parameter is recommended by the Landfill Directive); this approach will be retained.

8.10. With regard to List I and List II substances[38] the Guidance also emphasises the need to review trends in monitoring data to determine whether an impact is occurring.

MONITORING PROGRAMME

8.11. A leachate monitoring programme is found in **Table 8.1**; this table also provides typical detection limits. **Figure 8.1** and **Figure 8.2** show the leachate monitoring points; it is noted that LCP1-3 collection points have been closed off as no leachate was being found. New leachate monitoring points are and will continue to be added as new landfill cells are added.

8.12. Leachate sampling will comply with ISO 5667-1:2006 or equivalent.

[38] This terminology was used in the former Groundwater Directive (80/68/EEC), which was repealed by the Water Framework Directive (2000/60/EC).

Table 8.1: Leachate monitoring programme

Leachate monitoring points: LCP4-13, Z1-Z6					
Determinand	**Indicator monitoring**	**Characterisation monitoring**	**Control level**	**Trigger level**	**Typical detection limit**
	Frequency (months)				
Water level	3		0.80 m	1.0 m	
Conductivity	3				±3.4 µS/cm
Total dissolved solids	3				40 mg/L
pH	3				0.1 pH units
TOC	3				0.1 mg/L
NH_3-N	3		260 mg/L	1,000 mg/L	0.01 mg/L
Cl^-	3		1,000 mg/L	5,000 mg/L	0.05 mg/L
Phenol index	3				0.05 mg/L
F^-	3				0.05 mg/L
Fe		12			0.1 µg/L
SO_4		12			0.05 mg/L
Na		12			0.5 mg/L
K		12			0.5 mg/L
Mg		12			0.05 mg/L
Ca		12			0.05 mg/L
As	3		0.004 mg/L	0.4 mg/L	0.14 µg/L
Ba		12			0.1 µg/L
Cd	3		0.0002 mg/L	0.02 mg/L	0.1 µg/L
Cr	3		0.09 mg/L	0.4 mg/L	0.2 µg/L
Cu	3		0.05 mg/L	0.1 mg/L	0.3 µg/L
Hg		12			0.1 µg/L
Mo		12			1.0 µg/L
Ni	3		0.2 mg/L	0.6 mg/L	0.05 µg/L
Pb	3		0.1 mg/L	0.3 mg/L	0.1 µg/L
Sb		12			0.5 µg/L
Se		12			0.9 µg/L
Zn		12			4.1 µg/L
Hydrocarbons	3				1 µg/L
Screening List (**Appendix 3**)		12			

8.13. **Table 8.1** includes characterisation and indicator monitoring. The choice of parameters does not include all those parameters identified in the Guidance, as there is no evidence from the Environmental Impact Assessment or Hydrogeological Risk Assessment that all those parameters are critical. Conversely, the list of indicator parameters is more comprehensive than that suggested in the example schedule from the Guidance, as some parameters chosen are indicators of leachate treatability or treatment requirements, as well as polluting potential. The characterisation monitoring parameters are also chosen to reflect the complexity of processes

involved in the production and evolution of leachate, with significant variations likely to occur in the composition with time and between different parts of the landfill.

8.14. Assessment and compliance levels are also presented in Appendix 3 to the Site Management System. The control level for leachate head is set at 0.2 m below, and the Trigger level at, the specified maximum level of 1.0 m used in the Hydrogeological Risk Assessment. The chemical quality parameters used are also consistent with those used in the Hydrogeological Risk Assessment. However, the control levels for the metals are conservatively low, as are the trigger levels, in comparison with the maximum values used in the risk assessment. The ammoniacal nitrogen and, in particular, chloride assessment and compliance levels are low in comparison with the maximum used in the risk assessment and with measured values in leachate / condensate from the Maghtab landfill, with the minimum chloride compliance level being close to the minimum default value used in the risk assessment and less than 20 times the maximum value used, which is based on values from Maghtab, and only one quarter of the mode value chosen in the risk assessment. The high chloride levels in Maghtab leachate are thought to be more typical of that likely to be found in Malta due to the low rainfall in comparison with the UK where the "default values" used for leachate in the Landsim model used in the risk assessment are derived. Alternative control and trigger levels are proposed in **Table 8.1**, based on the mode value used in the risk assessment and the compliance (trigger) level set below the maximum used in the risk assessment. Both values compare reasonably with median and maximum values found for leachates from large landfills with a high waste input and relatively dry waste conditions in a study carried out in the UK[39].

8.15. It is noted that measurements indicate some exceedances of all the analytes where a control / trigger level is present; therefore the monitoring frequency stipulated in the former approved EMP will be retained (including quarterly monitoring for such parameters). As explained in the Annual Environmental Reports for the landfills, these exceedances are attributed to recirculation of the leachate, which leads to an increase in pollutant concentrations due to a combination of low rainfall levels and evaporation.

8.16. Monitoring of the parameters defined in the Screening List[40] will continue to be carried out annually from two leachate wells (one from Ghallis and one from Zwejra), as is the current practice.

8.17. Some changes to the Screening List are proposed following a review of 2014-2017 data, which revealed that the following parameters were not detected in any of the

[39] Robinson H (1995). *A Review of the Composition of Leachates from Domestic Wastes in Landfill Sites*. DoE. Report CWM/072/95.

[40] The Screening List was formerly called the List I screen, in accordance with the terminology of the former Groundwater Directive (80/68/EEC), which was repealed by the Water Framework Directive (2000/60/EC).

environmental media monitored (leachate, groundwater, surface water, seawater and sediment):

- Cyanides;
- Pesticides containing phosphate;
- Non-carcinogenic chlorinated aliphatic compounds;
- Brominated diphenylether; and
- Pentachlorobenzene.

8.18. The above parameters have therefore been removed from the Screening List. The list of carcinogenic chlorinated aliphatic compounds in the Screening List (**Appendix 3**) has also been modified to match that reported in Italian guidance[41].

CONTINGENCY PLAN

8.19. In the event that the control level is breached, or a trend in leachate quality leads to the conclusion that the control or trigger level might be breached in the future, the following protocol will be adopted:

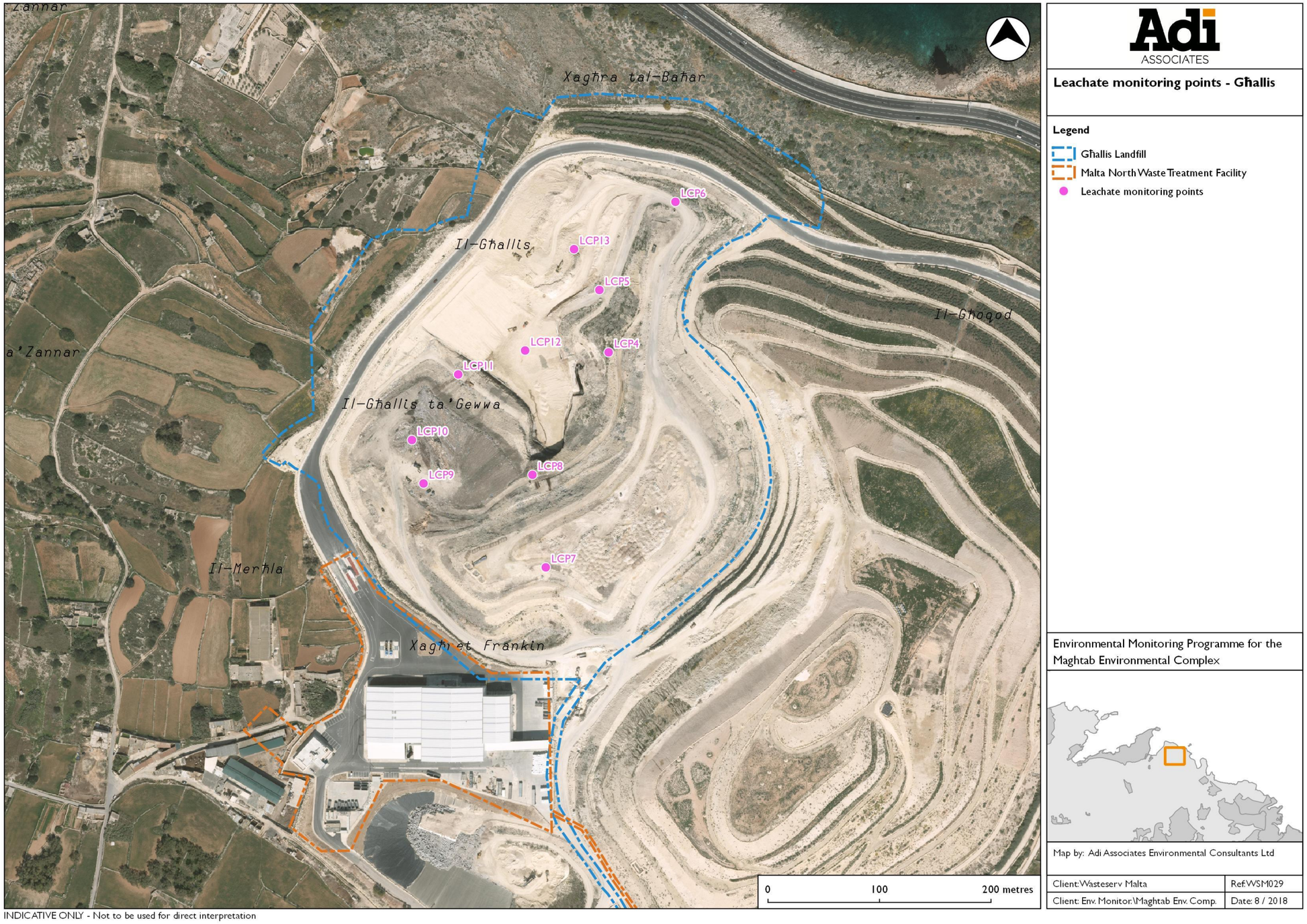
- The site management and ERA will be advised.
- The concentration of those parameters will be re-determined by repeat sampling and analysis.
- A review of site operations will be undertaken and actions taken to avoid further breach of control level or potential breach of trigger level.
- Increase monitoring frequency to monthly from quarterly to establish if the actions undertaken lead to a stabilization of leachate chemistry, or decline in upward trend in the concentration of the affected parameters.

8.20. In the event that the trigger level is breached, the following protocol will be implemented:

- Review the hydrogeological risk assessment in the light of higher assumed concentrations of the affected leachate parameters and the control and trigger levels.
- If the hydrogeological risk assessment leads to the conclusion that the impact on groundwater quality would be unacceptable, corrective measures will be implemented in agreement with ERA to reduce the risk.

[41] Italian decreto: ID152 of 2006. Part 4, Attachment 5, table 1 (non-listed on ERA current limits applied for contamination analyses)).

Figure 8.1: Leachate monitoring points (Ghallis landfill)



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Adi ASSOCIATES

Leachate monitoring points - Għallis

Legend

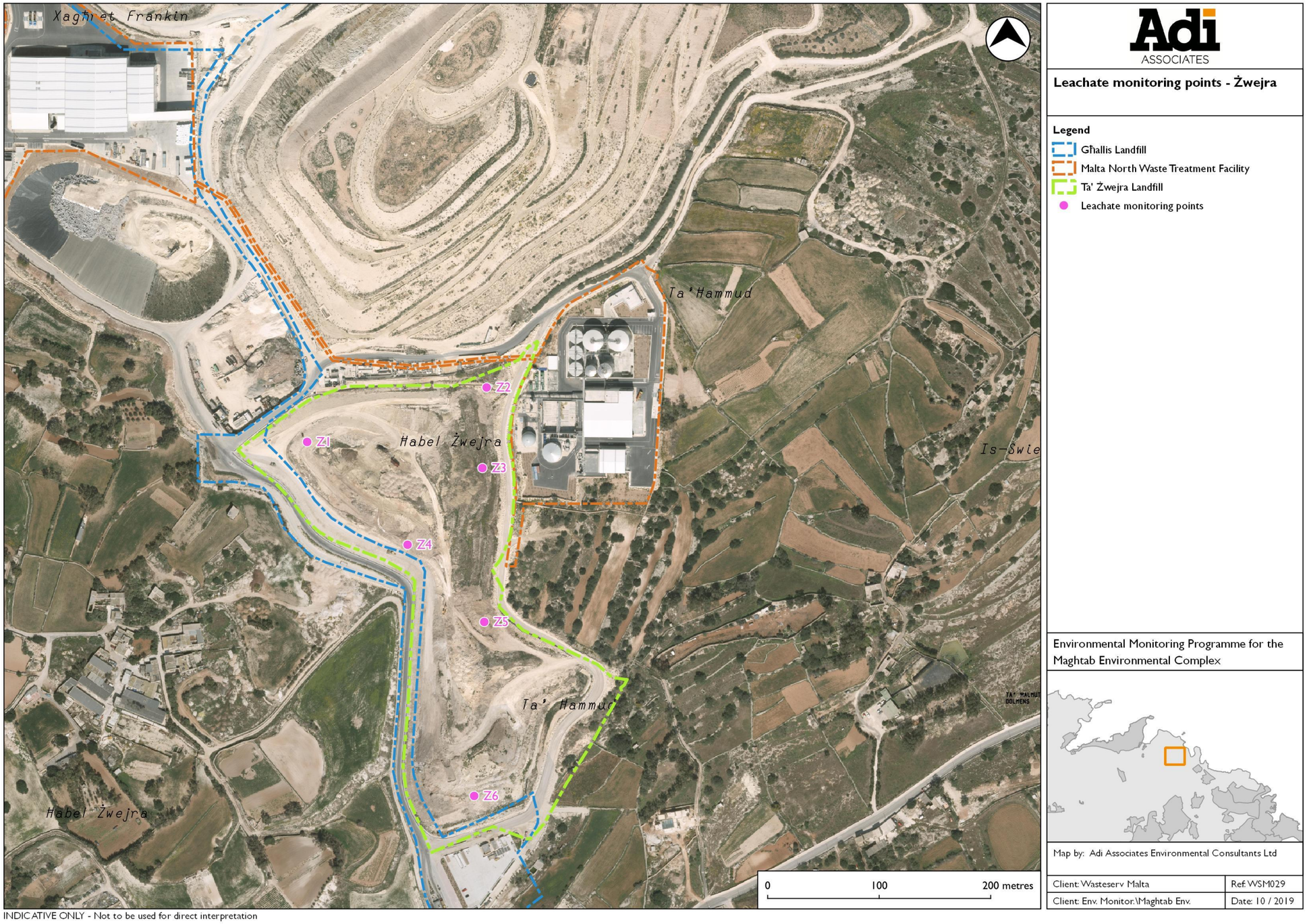
- Għallis Landfill
- Malta North Waste Treatment Facility
- Leachate monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 8 / 2018

Figure 8.2: Leachate monitoring points (Zwejra landfill)



INDICATIVE ONLY - Not to be used for direct interpretation

Adi ASSOCIATES

Leachate monitoring points - Żwejra

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- Leachate monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env.	Date: 10 / 2019

9. GROUNDWATER

MONITORING REQUIREMENTS AND GUIDANCE

9.1. This Chapter applies to the Ghallis and Zwejra landfills. The Industrial Emissions (Integrated Pollution Prevention and Control) Regulations, SL 549.77, require soil and groundwater monitoring where the activity involves the use, production or release of relevant hazardous substances and having regard to the possibility of soil and groundwater contamination at the site of the installation.

9.2. The Guidance for groundwater monitoring in relation to landfills is the same document as that for leachate monitoring,[42] and includes a recommendation for characterisation and indicator monitoring. Table 6.9 to the Guidance gives an example monitoring regime.

9.3. Table 6.8 to the Guidance reproduces the minimum monitoring frequency as required by the Landfill Regulations. For groundwater composition, the frequency is site specific.

9.4. With regard to the MNWTP, a Land and Groundwater Risk Assessment prepared for the site[43] had concluded that the risk to land and groundwater from the MNWTP was low and very low as a result of the planned mitigation measures, and that baseline monitoring[44] was not considered necessary. As a result, routine groundwater monitoring specific to this site is not required.

CURRENT PRACTICE

9.5. The former approved monitoring programmes required groundwater monitoring from a number of boreholes, as shown in **Table 9.1**. However, several of the boreholes have been removed from the Environmental Monitoring Programme, as described in this Table; four active boreholes remain (marked in bold in **Table 9.1**).

Table 9.1: Status of groundwater boreholes

Borehole reference	Sampling status
BH1	Sampled
BH2	Sampled
BH3	Damaged in 2013 and has not been sampled since then
BH4	Sampled
BH5	Damaged in 2014 and eventually removed due to the construction of the MNWTP
MBH5	Not available from 2015 onwards due to the Coast Road project

[42] Environment Agency (2003) *LFTGN02: Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water.*

[43] Adi Associates Environmental Consultants Ltd, 2022. *Malta North Waste Treatment Plant. Land and Groundwater Risk Assessment.* San Ġwann, September 2022; iv + 28 pp. + 2 Appendices.

[44] Adi Associates Environmental Consultants Ltd, 2022. Malta North Waste Treatment Plant. Baseline Land & Groundwater Monitoring Report. San Gwann, September 2022; iv + 36 pp.

Borehole reference	Sampling status
2130	Sampled. Classified as a background site as it is likely to be upstream of the landfills, however, there were still some exceedances of the control levels in recent years, and groundwater quality seems to have worsened considerably in recent years.
2041	No longer sampled; owner of borehole 2041 could no longer be reached after mid-2015
00574 (BH00574)	Private borehole, never sampled as the owner could not be reached
MBH1	In recent years the borehole was found to be dry
MBH3	In recent years the borehole was found to be dry; the borehole has also recently been damaged

9.6. Indicator monitoring is carried out at intervals of three months, and characterisation monitoring is carried out annually, as per the previous approved monitoring programme**.** However, monitoring of hydrocarbons has inadvertently been omitted. It is noted that the List 1 screen is monitored from only two of the boreholes each year.

9.7. Prior to sampling groundwater, the depth to the water surface and base of the borehole is measured and the volume of water in the borehole calculated. A minimum volume equivalent to three times that standing in the borehole is purged, either by baler or by dedicated pump to introduce "fresh" groundwater into the borehole. On-site parameters, such as pH, electrolytic conductivity and temperature are measured on completion of purging and observations such as odour, colour and appearance recorded. Sample bottles and tops are rinsed in sample water (unless pre-loaded with preservatives). Sample bottles are filled to the top to minimise air entrapment and the cap screwed firmly on. Sample bottles are labelled and stored in "cool boxes" for shipment to the laboratory.

MONITORING STRATEGY

9.8. The location of the groundwater monitoring points is shown in **Figure 9.1**. Most of the currently active boreholes (BH2, BH4 and 2130) will be maintained. However, since BH1 and BH2 were located very close together, as agreed with the Energy and Water Agency (EWA), BH1 will be replaced by BH6; this location has been selected as it is possibly downstream of the Ghallis landfill. A new borehole (3308) will also be added; this new point has been selected due to its proximity to the Zwejra landfill, and the likelihood that it is downstream of the site. Monitoring from boreholes BH6 and 3308 will start in 2021, after expiry of the current tender.

9.9. In order to help ensure WasteServ's continued access to the boreholes for monitoring and the maintenance of the boreholes in good working order, the agreement in **Appendix 4** has been signed by the owners of the private boreholes included in this EMP.

9.10. The proposed list of parameters, monitoring frequency and associated detection limits are given in **Table 9.2**.

Table 9.2: Groundwater monitoring programme

Groundwater monitoring points: BH2, BH4, BH6, 3308 and 2130					
Determinand	**Indicator monitoring**	**Characterisation monitoring**	**New control level** (µg/L)	**New trigger level** (µg/L)	**Typical detection limit**
	Frequency (months)				
Water level	3				
Conductivity	3		3,600	4,500 µS/cm	±3.4 µS/cm
pH	3				0.1 pH units
TOC	3				0.1 mg/L
NH_3-N		12			0.01 mg/L
Cl^-	3		900,000	1,000,000	0.05 mg/L
F^-		6	800	1,500	0.05 mg/L
Phenol index		6			0.05 mg/L
Fe	3		100	200	0.1 µg/L
SO_4	3		350,000	475,000	0.05 mg/L
Na	3		435,000	450,000	0.5 mg/L
K		12			0.5 mg/L
Mg		12			0.05 mg/L
Ca		12			0.05 mg/L
As	3		3.9	10	0.14 µg/L
Ba		12			0.1 µg/L
Cd	3		2.5	5	0.025 µg/L
Cr	3		20	50	0.2 µg/L
Cu	3		514	1,000	0.3 µg/L
Hg		12	0.5	1	0.1 µg/L
Mo		12			1.0 µg/L
Ni	3		8.6	20	0.05 µg/L
Pb	3		9.8	10	0.1 µg/L
Sb		12	2.5	5	0.5 µg/L
Se		12	5	10	0.9 µg/L
Zn	3		1,600	3,000	4.1 µg/L
Hydrocarbons	3		To be determined once monitoring starts	350	1 µg/L
Screening list (**Appendix 3**)		12		**Appendix 3**	

9.11. The monitoring frequencies have been revised as follows:

- Ammoniacal nitrogen: Monitoring every 12 months, since readings are typically very low and often below the detection limit;
- Fluoride, phenol index: Monitoring every 6 months, since although readings are also typically very low and often below the detection limit, these parameters are included in Schedule 3 (Part 4B) of the Waste Management (Landfill) Regulations (S.L.549.29); and

- Iron, sulphate, sodium, zinc: Monitoring every 3 months, due to the presence of a new trigger level, which in recent years has sometimes been exceeded or approached. It is noted that Maltese groundwater threshold values are applicable for some parameters, however, when a threshold value is not available for particular parameters, ERA applies Italian reference values.

9.12. **Table 9.2** also includes new control and trigger levels. As noted in the Hydrogeological Risk Assessment (HRA)[45] carried out for Ghallis landfill:

- **Control levels** are assessment criteria used to determine whether a landfill is performing as designed. They are intended to draw the attention of site management and the regulatory authorities to the development of adverse, or unexpected, trends in the monitoring data. Such trends may results from failure of site engineering or management, or from variations between actual conditions and those assumed within the conceptual model. Control levels should be treated primarily as an early warning system to enable appropriate investigative or corrective measures to be implemented, particularly where there is potential for a trigger level to be breached; and

- **Trigger levels** are specific compliance levels or regulatory standards. They are defined as criteria at which significant adverse environmental effects and / or breaches of legislation have occurred. Such effects would be consistent with the groundwater having been polluted.

9.13. UK guidance[46] states that control levels are typically set at a level between the concentration predicted in groundwater as part of the HRA process and the trigger level. In light of the new trigger levels, the former control levels for the parameters modelled in the HRA were reviewed (**Table 9.3**) and were mostly found to still be appropriate, with the exception of cadmium and lead, which are being raised to mid-way between the predicted concentration and the trigger level. For other parameters not modelled in the HRA that have a trigger level, the control level has been set at mid-way between the value measured at the background monitoring borehole 2130[47] for the earliest year available (2011) and the trigger level.

[45] SLR (2004) *Ghallis Landfill, Malta: Hydrogeological Risk Assessment.*
[46] Environment Agency (2003) *LFTGN01: Hydrogeological Risk Assessments for Landfills.*
[47] Control levels for conductivity, chloride, and sodium were set on the basis of the value measured at borehole BH2 in 2011, since the 2011 annual average at borehole 2130 was already higher than the trigger level (probably due to seawater intrusion).

Table 9.3: Review of groundwater control levels

Parameter	95%ile predicted peak concentrations[45] (µg/L)	Former control level (µg/L)	New trigger level (µg/L)	Comments on existing control level
As	1.9	3.9	10	Appropriate
Cd	<0.1	0.05	5	Raise to 2.5 µg/L
Cr	10.5	20	50	Appropriate
Cu	18	514	1,000	Appropriate
Ni	4.8	8.6	20	Appropriate
Pb	9.6	5	10	Raise to 9.8 µg/L

9.14. The trigger levels in the former approved Environmental Monitoring Programme were based on UK Drinking Water Standards[48]. However, as mentioned ERA is currently using Maltese[49] and Italian thresholds[50] as reference values; therefore it is considered that these reference values should be considered as the new trigger levels, in order to ensure that groundwater data assessment is harmonised across Malta. The new trigger levels are included in **Table 9.2**.

9.15. Monitoring of the parameters defined in the Screening List will continue to be carried out annually from two boreholes (one in the vicinity of Ghallis and one in the vicinity of Zwejra) on a rotational basis, as is the current practice. It is noted that the list of parameters included in the Screening List has been updated, as described in **Chapter 8**.

CONTINGENCY PLAN

9.16. In the event that the control level is breached, or a trend in groundwater quality in any borehole leads to the conclusion that the Control or Trigger Level might be breached in the future, the following protocol will be adopted:

i. The site management and ERA will be advised;

ii. The concentration of those parameters will be re-determined by repeat sampling and analysis;

iii. The borehole will be pumped for an extended period in an attempt to increase confidence that the quality is representative of groundwater quality, and not as a result of substances introduced to the borehole from the surface or near surface;

[48] The trigger level for cadmium was, however, set at the maximum concentration (as the model showed that levels should be below this concentration).
[49] SEWCU, ERA. *The 2nd Water Catchment Management Plan for the Malta Water Catchment District 2015 – 2021*. https://era.org.mt/en/Documents/2nd_Water_Catchment_Management_Plan-Malta_Water_in_Maltese_Islands.pdf.
[50] Current limits applied by the ERA for contamination analyses are as per Italian Decreto 152 of 3rd April 2006.

iv. A review will be carried out of leachate quality to establish if there is a potential link between trends in leachate quality and groundwater quality, or between background (upstream) groundwater quality and in the affected borehole(s);

v. In the event that there is no apparent relationship between leachate quality or upstream groundwater quality and the quality in the affected borehole(s), a review will be carried out of land-use and activities between the landfill boundary and the borehole(s) affected to seek to eliminate external sources of the contaminant(s);

vi. In the event that no external source of contaminant(s) is identified, a review of site operations will be undertaken and actions taken to avoid further breach of Control level or potential breach of Trigger level. It is considered likely that actions considered will include, but not necessarily be limited to, the reduction in leachate head within the landfill; and

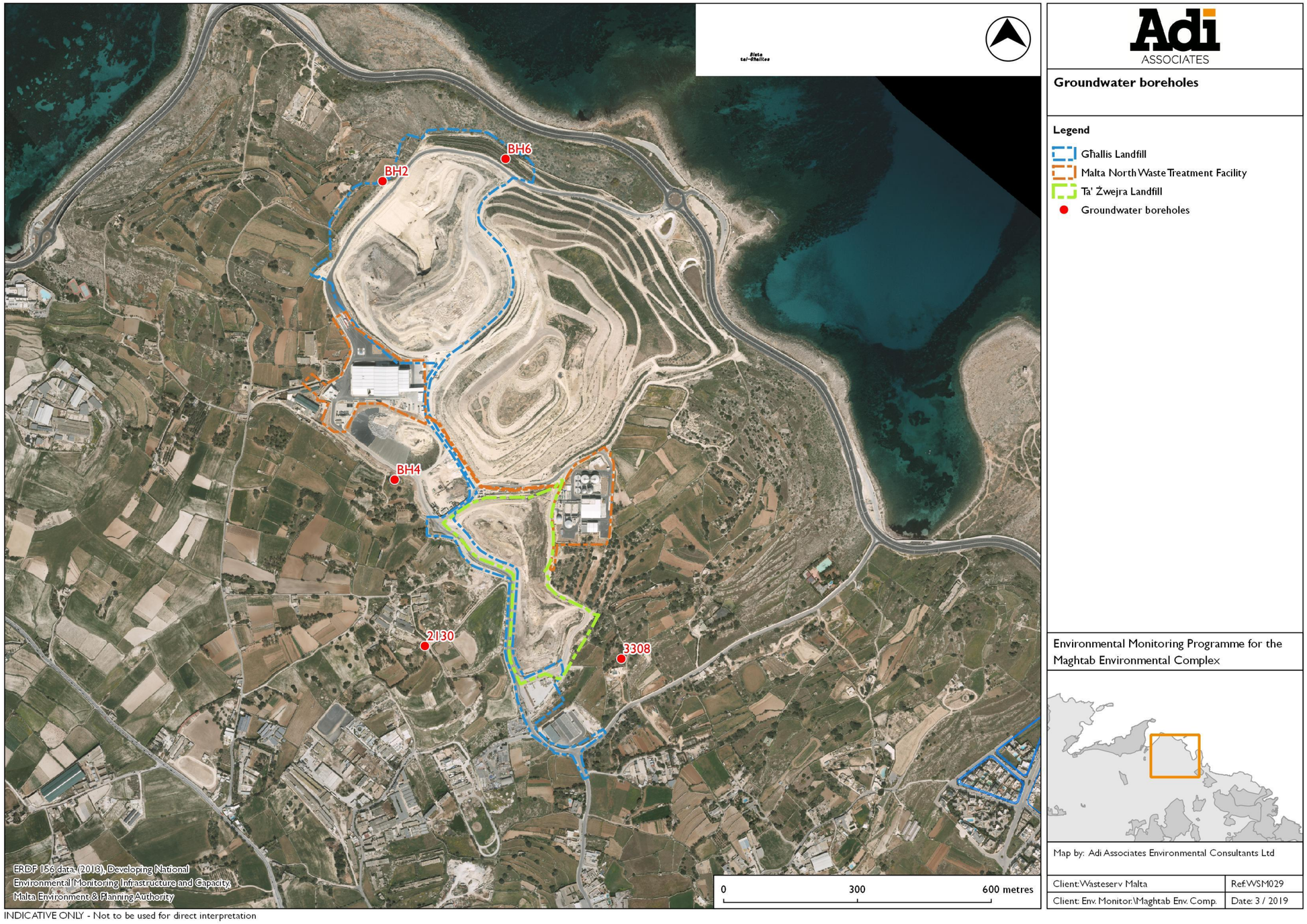
vii. The monitoring frequency will be increased from quarterly to monthly to establish if the actions undertaken lead to a stabilisation of groundwater quality, or a decline in upward trend in the concentration of the affected parameters.

9.17. In the event that the Trigger Level is breached, the following protocol will be implemented:

i. Review the hydrogeological risk assessment in the light of higher assumed concentrations of the affected leachate parameters and the Control and Trigger levels; and

ii. If the hydrogeological risk assessment leads to the conclusion that the impact on groundwater quality would be unacceptable, implement corrective measures in agreement with ERA to reduce the risk.

Figure 9.1: Groundwater monitoring points



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10. ON-SITE SURFACE WATER

10.1. This Chapter applies to the Ghallis and Zwejra landfills, since monitoring for on-site surface water at the MNWTP is not required as there are no surface water features at the MNWTP.

UK GUIDANCE

10.2. UK guidance[51] recommends monitoring of surface water features, namely from:

- water courses;
- ponds, lakes and wetlands;
- discharge points; and
- sediments.

CURRENT PRACTICE

10.3. Although the former EMP requires sampling of on-site surface water at sampling locations SW1, SW2 and SW3 (at the perimeter drain), in practice sampling was being carried out from rainwater puddles as soon as possible after a rainfall event (before the rainwater drains away), since very little water accumulates in the perimeter drain.

10.4. Therefore, the samples collected were not reflective of the quality of surface water features but represented relatively clean rainwater samples.

10.5. It is therefore proposed that surface water samples will start to be collected from the following surface water features at the landfills (**Figure 10.1**):

- Reservoir at Zwejra (SW4); and
- Silt pond at Ghallis (which also collects surface water runoff from the Maghtab dump; SW5).

10.6. As a result of the current operations at the scheme, a new source of surface runoff shall be discharged to the Reservoir at Zwejra (SW4) (**Figure 10.1**).

[51] Environment Agency (2003) *LFTGN02: Guidance on Monitoring of Landfill Leachate, Groundwater and Surface Water.*

MONITORING PROGRAMME

10.7. Water samples are collected using bailers or other transfer vessels before pouring water into sample containers. Where the water is deep enough, sample containers are filled directly within the surface water feature after rinsing with sample water.

10.8. In the previous monitoring programme, characterisation monitoring was carried out at intervals of 12 months whereas indicator monitoring was carried out every 3 months (or in both cases, following significant rainfall if dry). This frequency will be retained since new monitoring points are being set up, with a possibility of revision following a year of monitoring.

10.9. The list of parameters and detection limits are given in **Table 10.1**. The range of parameters is designed to reflect the leachate and groundwater monitoring protocols.

Table 10.1: On-site surface water monitoring

On-site surface water monitoring points: SW4, SW5					
Determinand	**Indicator monitoring**	**Characterisation monitoring**	**New control level** (µg/L)	**New trigger level** (µg/L)	**Typical detection limit**
	Frequency (months)				
Water level	3				
Conductivity	3		3,600	4,500 µS/cm	±3.4 µS/cm
Total dissolved solids	3				40 mg/L
pH	3				0.1 pH units
TOC	3				0.1 mg/L
NH_3-N	3				0.01 mg/L
Cl^-	3		900,000	1,000,000	0.05 mg/L
F^-	3		800	1,500	0.05 mg/L
Phenol index	3				0.05 mg/L
Fe		12	100	200	0.1 µg/L
SO_4		12	350,000	475,000	0.05 mg/L
Na		12	435,000	450,000	0.5 mg/L
K		12			0.5 mg/L
Mg		12			0.05 mg/L
Ca		12			0.05 mg/L
As	3		3.9	10	0.14 µg/L
Ba		12			0.1 µg/L
Cd	3		2.5	5	0.025 µg/L
Cr	3		20	50	0.2 µg/L
Cu	3		514	1,000	0.3 µg/L
Hg		12	0.5	1	0.1 µg/L
Mo		12			1.0 µg/L
Ni	3		8.6	20	0.05 µg/L
Pb	3		9.8	10	0.1 µg/L
Sb		12	2.5	5	0.5 µg/L
Se		12	5	10	0.9 µg/L
Zn		12	1,600	3,000	4.1 µg/L

On-site surface water monitoring points: SW4, SW5					
Determinand	**Indicator monitoring**	**Characterisation monitoring**	**New control level** (µg/L)	**New trigger level** (µg/L)	**Typical detection limit**
	Frequency (months)				
Hydrocarbons	3		To be determined once monitoring starts	350	1 µg/L
Screening list (**Appendix 3**)		12		**Appendix 3**	

10.10. Since surface water will normally discharge to the groundwater by infiltration (unless collected), it is considered that the Control and Trigger levels adopted for groundwater are appropriate for surface water quality.

CONTINGENCY PLAN

10.11. In the event that the control level is breached, or a trend in surface water quality in at any monitoring point leads to the conclusion that the Control or Trigger Level might be breached in the future, the following protocol will be adopted:

i. The site management and ERA will be advised;

ii. The concentration of those parameters will be re-determined by repeat sampling and analysis (if there is any water remaining);

iii. A review will be carried out of surface water quality at the different monitoring points to seek to establish at what part of the surface water drain contaminant(s) enter the system; this may also include a review of groundwater monitoring data and surface water pathways, to establish whether the breach is leading to a reduction in groundwater quality;

iv. In the event that the review identifies potential sources of contaminated run-off from Ghallis or Zwejra a survey will be carried out of activities on the landfill or potential sources of perched leachate outbreak;

v. In the event that no clear source of contaminant(s) is identified, a review of site operations will be undertaken and actions taken to avoid further breaches of Control levels or potential breaches of Trigger levels. It is considered likely that actions considered will include, but not necessarily be limited to, the reduction in leachate head within the landfill and cessation of leachate re-circulation in affected areas; and

vi. The monitoring frequency will be increased to include any significant rainfall event leading to the accumulation of water at the sampling points to establish if the actions undertaken lead to a stabilisation of on-site surface water and / or groundwater quality, or a decline in upward trend in the concentration of the affected parameters.

Figure 10.1: On-site surface water monitoring points

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Adi ASSOCIATES

On-site surface water monitoring points

Legend

- Ghallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- On-site surface water monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client:Wasteserv Malta	Ref:WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 3 / 2019

11. COASTAL WATERS AND SEDIMENT

11.1. This Chapter applies to the Ghallis and Zwejra landfills, since monitoring of coastal water and sediment is not relevant to the MNWTP, given that no discharges to seawater are expected from this facility.

MONITORING LOCATIONS

11.2. Five monitoring stations are used for water and sediment sampling (A-D, with E included recently). Two of the stations, A and B (**Figure 11.1**), are sited in the vicinity of the waste facility and have been selected for the assessment of discharges to coastal water that may potentially originate from the facility. Stations C and D (**Figure 11.1**) serve as reference stations from where background physico-chemical data is recorded. Station E was added as requested by the former MEPA (now ERA).

11.3. Each station is located at a distance of 10 metres from the shore, however, if it transpires that no sediments are present at this distance from the shore, the location of the station will be adjusted such that the alternative site will be located on a soft bottom but as close as possible to the 10 m horizontal distance mark.

11.4. The locations of the proposed monitoring station have been carefully selected, such that:

- Stations A, B and E are in the vicinity of the waste facility are located as practically close to it as possible.
- The two reference stations are located in waters that are relatively free from polluting sources.
- Incorporating three putatively impacted stations and two reference stations renders the monitoring design sufficiently robust, while enabling rigorous statistical treatment of data, if required.

11.5. In accordance with the previous monitoring programme, monitoring of sediments will continue to be carried out annually, to allow detection of any long-term changes; monitoring of coastal water will continue to be carried out quarterly / annually depending on the parameter.

LIST OF PARAMETERS

11.6. The parameters that will be monitored in the water and sediments as part of this coastal water monitoring programme are as given in **Table 11.1** and **Table 11.2**. The parameters are aligned with the leachate monitoring programme.

Table 11.1: Coastal water monitoring programme

Coastal water monitoring points A-E						
Determinand	**Indicator monitoring**	**Characterisation monitoring**	**Environmental Quality Standard** (µg/L)		**Ideal limit of quantification (LOQ)**[52]	**Typical detection limit**
	Frequency (months)		**Annual average**	**Max. allowable concentration**		
Water level	3					
Conductivity	3					±3.4 µS/cm
pH	3					0.1 pH units
Water hardness[53]		12				
TOC	3					0.1 mg/L
NH_3-N	3					0.01 mg/L
Cl^-	3					0.05 mg/L
F^-	3					0.05 mg/L
Phenol index	3					0.05 mg/L
Fe		12				0.1 µg/L
SO_4		12				0.05 mg/L
Na		12				0.5 mg/L
K		12				0.5 mg/L
Mg		12				0.05 mg/L
Ca		12				0.05 mg/L
As	3					0.14 µg/L
Ba		12				0.1 µg/L
Cd	3		0.2	≤0.45 – 1.5[54]	0.06 µg/L	0.025 µg/L
Cr	3					0.2 µg/L
Cu	3					0.3 µg/L
Hg	3			0.07	0.02 µg/L	0.05 µg/L
Mo		12				1.0 µg/L
Ni	3		8.6	34	2.58 µg/L	0.05 µg/L
Pb	3		1.3	14	0.39 µg/L	0.1 µg/L
Sb		12				0.5 µg/L
Se		12				0.9 µg/L
Zn	3					4.1 µg/L
Hydrocarbons	3					1 µg/L
PCDD/PCDF		12[55]				0.1 µg/L

[52] LOQ has been set at 30% of the value of the AA-EQS; this is to be met to the extent possible and takes precedence over the typical detection limit quoted in **Table 11.1**. If this ideal LOQ is not achievable, the Contractor is required to demonstrate that the best available analytical techniques are used, and the reliability of the data must also be ensured through QA/QC procedures that satisfy criteria related to reproducibility, accuracy and precision of the methodology.

[53] Parameter added to enable the determination of the correct EQS for Cd; see next footnote.

[54] The EQS varies depending on the hardness of the water, as specified in five class categories (Class 1: <40 mg $CaCO_3$/L; Class 2: 40 to <50 mg $CaCO_3$/L; Class 3: 50 to <100 mg $CaCO_3$/L; Class 4: 100 to <200 mg $CaCO_3$/L ; and Class 5: ≥200 mg $CaCO_3$/L).

[55] To be monitored only if gas flaring is regularly carried out (>10% of the year).

Screening list (**Appendix 3**)		12				

Table 11.2: Sediment monitoring programme

Sediment monitoring points A-E			
Determinand	**Indicator monitoring**	**Characterisation monitoring**	**Typical detection limit**
	Frequency (months)		
Granulometry	12		63 µm
TOC	12		
NH_3-N	12		0.1 mg/kg
Cl^-	12		
F^-	12		0.1 mg/kg
Phenol index	12		
Fe		12	0.1 mg/kg
SO_4		12	0.1 mg/kg
Na		12	0.1 mg/kg
K		12	0.1 mg/kg
Mg		12	0.1 mg/kg
Ca		12	0.1 mg/kg
As	12		0.1 mg/kg
Ba		12	0.1 mg/kg
Cd	12		0.1 mg/kg
Cr	12		0.1 mg/kg
Cu	12		0.1 mg/kg
Hg		12	0.1 mg/kg
Mo		12	0.1 mg/kg
Ni	12		0.1 mg/kg
Pb	12		0.1 mg/kg
Sb		12	0.1 mg/kg
Se		12	0.1 mg/kg
Zn		12	0.1 mg/kg
Hydrocarbons	12		0.1 mg/kg
PCDD/PCDF		12[56]	0.01 µg/kg
Screening list (**Appendix 3**)		12	

11.7. The list of parameters (including the Screening List, which has been updated as described in **Chapter 8**) also includes a number of relevant pollutants arising from Water Policy Framework Regulations obligations (S.L. 549.100, Schedule IX). The applicable Environmental Quality Standards (EQS) for surface waters, set by these Regulations, are now also included in **Table 11.1**.

[56] To be monitored only if gas flaring is regularly carried out (>10% of the year).

11.8. The previously approved monitoring frequencies will be retained. It is noted that for seawater, the main pollutants that are either covered by an EQS or that were at times detected at elevated concentrations are already being monitored quarterly.

11.9. A review of 2014-2017 data has revealed that PCDD/PCDF (which was included in the approved EMP on request from the then-MEPA) was:

- never detected in seawater (limits of detection ranging from 0.1 µg/L to 0.004 µg/L); and
- only detected in 2014 in trace amounts in sediments (0.0001 to 0.0073 µg/kg); in other years it was not detected (the limits of detection were 0.1 µg/kg to 0.01 µg/kg).

11.10. In view of these results as well as the minimal current potential for PCDD/F generation from the landfills, it is proposed that in future this parameter would only be monitored if the flare starts to be used regularly (>10% of the year). It is noted that the flare is not currently in use and there are currently no plans for its future operation.

SAMPLING PROCEDURES

11.11. To monitor seawater, sampling is carried out at each station at a water depth of 0.5 m below the surface and at a water depth corresponding to a level that is 0.5 m above the seabed. Two replicate samples are collected from each of the two water depths at each of the four stations. Levels of dissolved oxygen and temperature are recorded using an in-situ multi-parameter meter. For the remaining attributes, water samples are collected using a Van Dorn sampler and transferred to polyethylene or glass containers, depending on the attribute to be measured. All water sampling is carried out in accordance with ISO 5667-1:2006 and ISO 5667-3:2018. Sample preservation techniques follow guidance given in ISO 5667-3:2018 for the respective attribute.

11.12. Sediment sampling is carried out manually by SCUBA divers. Two replicate samples are collected from each monitoring station using plastic corers. Sediment sampling is carried out in accordance with ISO 5667-12:2017 and ISO 5667-19:2004. Sample preservation techniques follow guidance given in ISO 5667-3:2018 for the respective parameters.

ANALYTICAL METHODOLOGY

11.13. For the analysis of chemicals in seawater, the aqueous component is reported. For the analysis of cadmium, lead, mercury and nickel, the water sample will be filtered prior to the analysis through a 0.45 µm filter or any equivalent pre-treatment, such that in accordance with Directive 2008/105/EC, Annex I, Part B, Point 3, the analysis is undertaken on the dissolved phase. For the chemical analysis of sediments, bound fractions are brought into solution by an initial process of acid extraction.

11.14. The water and sediment samples should be analysed according to international, European or national standard methodology. The analysis should be carried out by a laboratory accredited according to the ISO/IEC 17025:2017 standard or in the process of achieving such accreditation. The limits of detection for each respective analytical method used for the water and sediment analysis should typically meet or be lower than the values shown in **Table 11.1** and **Table 11.2**.

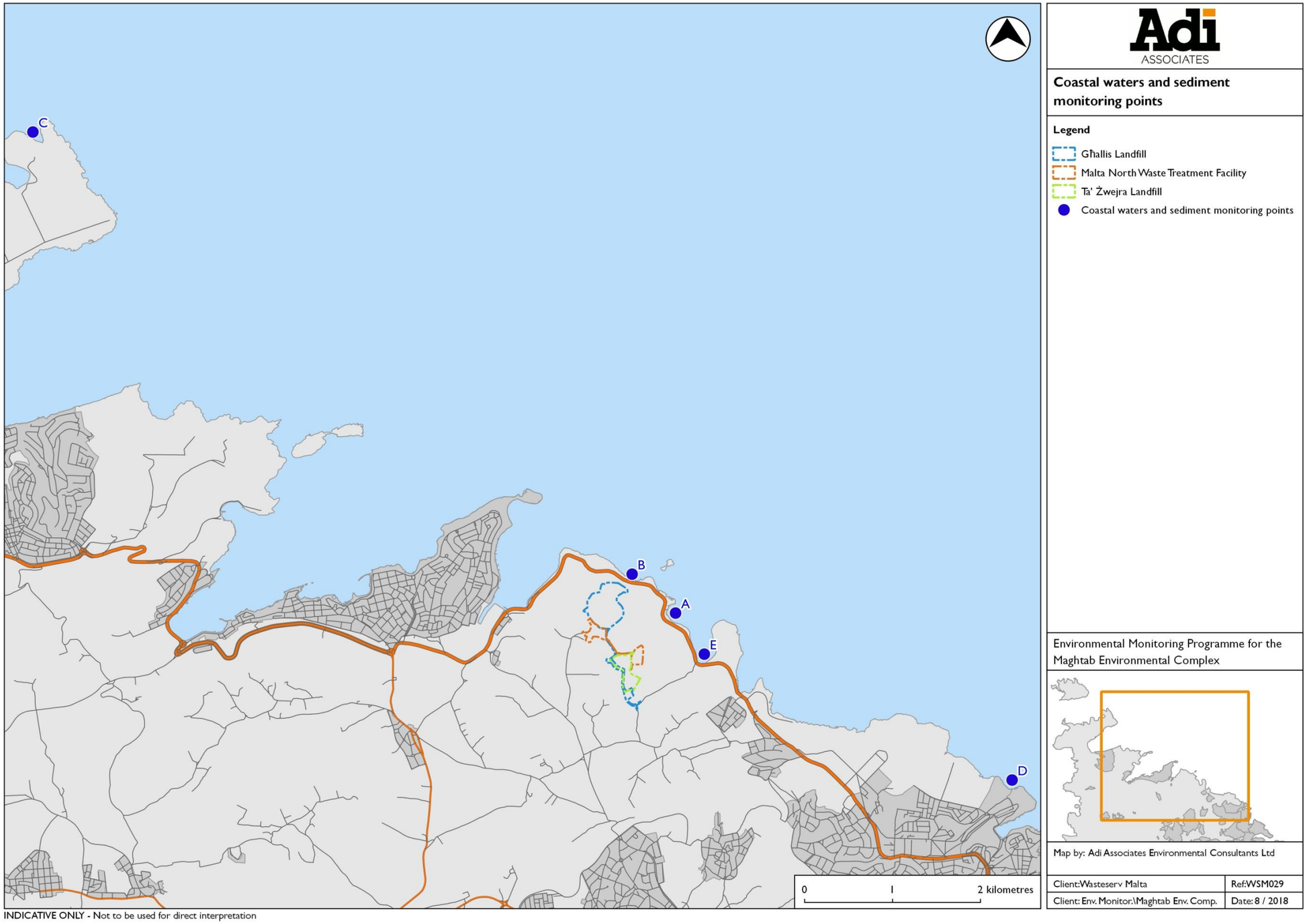
11.15. The laboratory that will undertake the analysis should provide the details of the methods that would be used, the reference of the method if this is an international or European standard or the principle of the methodology for national standards or in-house methods. The concentration levels of the chemicals parameters recorded for the individual samples are to be reported, including the laboratory certificate for each analysed sample with U = analytical uncertainty, K = coverage factor and R = recovery.

CONTINGENCY PLAN

11.16. If an exceedance of the annual average or maximum allowable concentration EQS at sampling points A, B or E is noted, the following protocol will be adopted:

- The site management and ERA will be advised.
- The concentration of those parameters will be re-determined by repeat sampling and analysis.
- A review will be carried out of leachate quality to establish if there is a potential link between trends in leachate quality and seawater/sediment quality.
- A review will be carried out of reference stations C and D to establish whether background seawater / sediment concentrations have increased.
- In the event that there is no apparent relationship between seawater / sediment quality and leachate quality, and no increase in background concentrations at the reference stations, a review will be carried out of land-use and activities between the landfill boundary and affected sampling point to identify whether external sources of the contaminant(s) could have affected the sample. In particular, if station E is affected, the potential influence of runoff originating from agricultural activities at Maghtab will be examined.
- In the event that no external source of contaminant(s) is identified, a review of site operations will be undertaken and actions taken to avoid further increases. It is considered likely that actions considered will include, but not necessarily be limited to, the reduction in leachate head within the landfill.
- The monitoring frequency will be increased to monthly to establish if the actions undertaken lead to a stabilisation of seawater / sediment concentrations, or a decline in upward trend in the concentration of the affected parameters.

Figure 11.1: Coastal waters & sediment monitoring points



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12. DISCHARGES TO SEWER

12.1. This Chapter applies to the MNWTP, since there is no discharge of trade effluent to sewer from the Ghallis and Zwejra landfills.

MONITORING REQUIREMENTS

12.2. The MNWTP has four discharge points to sewer, E1 to E4. Discharge points E2 to E4 refer to sanitary waste cesspits, and so no monitoring is required. Treated wastewater from the anaerobic digestor's wastewater treatment plant is collected in an underground reservoir (E1, shown in **Figure 12.1**), collected by a waste carrier and discharged to an off-site discharge point.

12.3. The Operator is currently in discussions with the Water Services Corporation (WSC) regarding the issue of a sewer discharge permit for the MNWTP as required by the Sewer Discharge Control Regulations, S.L. 545.08. As part of this process, the Operator has undertaken several monitoring sessions of effluent discharges.

12.4. Monitoring requirements and limit values will be set by the WSC once the sewer discharge permit is granted. It is anticipated that these would be based on Schedule C of the Regulations, however, some temporary limit values will be applied for a limited period until WasteServ invests in further treatment of the effluent in order to attain compliance with these limits.

12.5. An indicative monitoring programme for discharges to sewer is presented in **Table 12.1**; this is based on current discussions with the WSC regarding the applicable parameters and includes the limit values that have been indicated to the Operator to date. It is noted that the final monitoring programme that will be implemented will comply with the requirements of the Sewer Discharge Permit, once this is issued. Additionally, in agreement with WSC, in future WasteServ may carry out in-house analysis for certain parameters, if this is preceded by a period of parallel measurements with the WSC laboratory, and the results obtained are comparable.

Table 12.1: Indicative sewer discharges monitoring programme

Sewer discharge monitoring point E1		
Determinand	**Monitoring frequency**	**Indicative limit value**
pH	As directed by WSC	6 to 10
Temperature	As directed by WSC	40° C
BOD[57]	As directed by WSC	780 mg/L (temporary limit value; once further treatment is installed the limit value will be 500 mg/L)

[57] As requested by the WSC, BOD and COD are also to be measured from the inlet of the Sequence Batch Reactor (SBR), as shown in **Figure 12.1**, as well as from the outlet (point E1 as shown in **Figure 12.1**).

Sewer discharge monitoring point E1		
Determinand	**Monitoring frequency**	**Indicative limit value**
COD[57]	As directed by WSC	1,650 mg/L (temporary limit value; once further treatment is installed the limit value will be 1,000 mg/L)
Total suspended solids	As directed by WSC	1,000 mg/L
Settleable solids	As directed by WSC	20 ml/L
Metals and metalloids, as per **Table 12.2**	As directed by WSC	As per Schedule C of the Sewer Discharge Control Regulations (S.L 545.08)
Chloride	As directed by WSC	1,000 mg/L
Nitrate (as NO_3-N)	As directed by WSC	n/a
Total Kjeldahl Nitrogen	As directed by WSC	182 mg/L (temporary limit value; once further treatment is installed the limit value will be 150 mg/L)
Total phosphorous	As directed by WSC	8 mg/L

Table 12.2: Monitoring for metals and metalloids

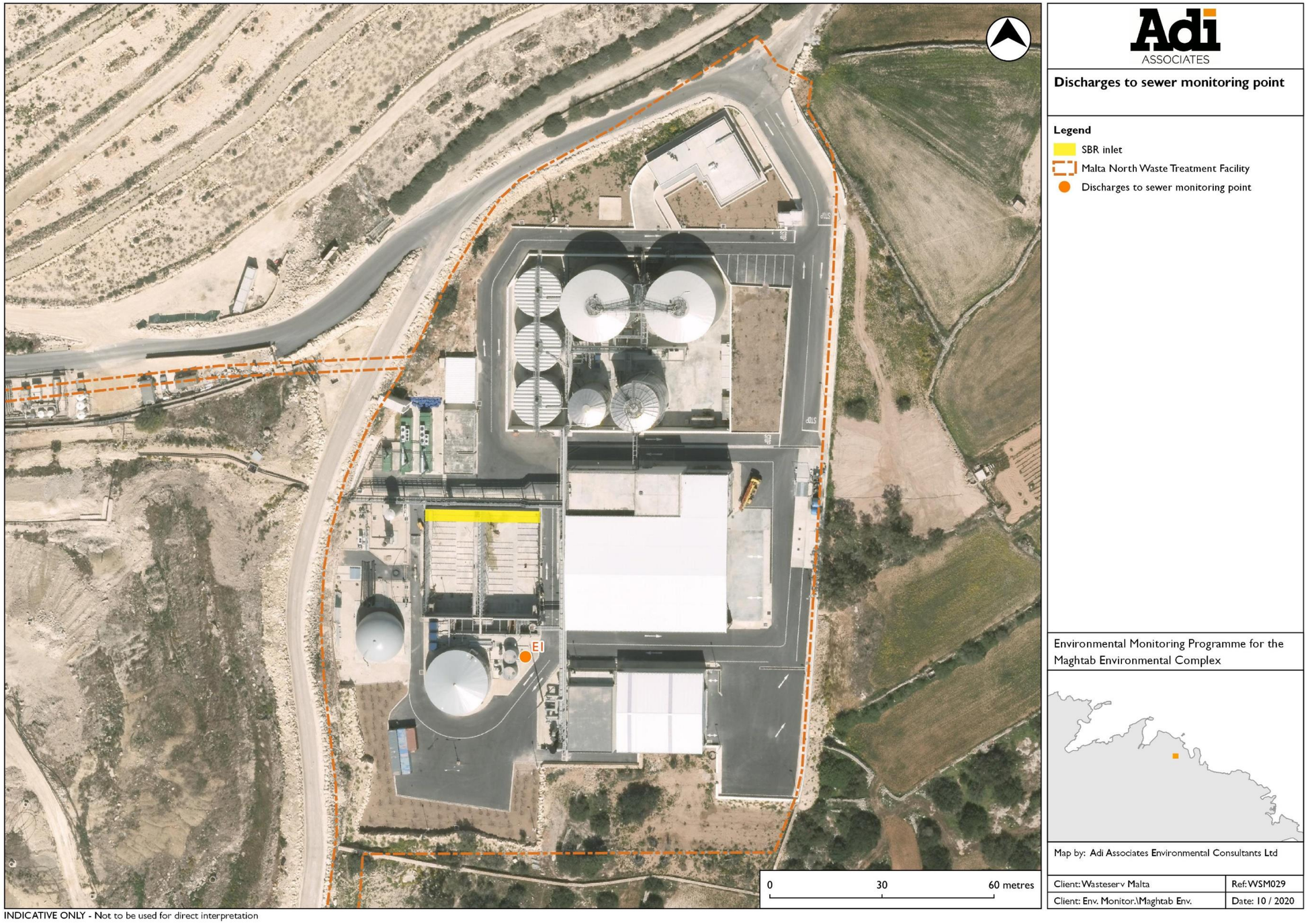
Analyte	**Monitoring methodology**	**Limit of quantification (mg/L)**
Arsenic	EN / ISO method or equivalent, based on ICP-MS or ICP-OES (the monitoring methodology will be identified by the Contractor awarded the works)	<0.01
Cadmium		<0.01
Chromium		<0.01
Copper		<0.05
Lead		<0.05
Nickel		<0.05
Mercury		<0.0005
Zinc		<0.1
Silver		<0.1
Selenium		<0.1
Antimony		<0.1
Molybdenum		<0.1
Titanium		<0.1
Tin		<0.1
Barium		<0.1
Beryllium		<0.1
Boron		<0.1
Uranium		<0.1
Vanadium		<0.1
Cobalt		<0.1
Thallium		<0.1
Tellurium		<0.1

CONTINGENCY PLAN

12.6. The following procedure will be followed if an exceedance of the limit value specified in the Sewer Discharge Permit is noted:

- The site management and WSC will be informed.
- A second sample will be taken at the earliest opportunity, in order to establish whether the exceedance was due to a temporary spike in emissions or indicative of a longer-term problem.
- If the exceedance is confirmed in second sample, a review will be carried out of operations (particularly the effectiveness of the wastewater treatment plant) in order to identify potential solutions.
- Once the identified solution is implemented, a wastewater sample will be retaken.

Figure 12.1: Monitoring point for discharges to sewer



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13. SOIL AND CROPS

13.1. This Chapter applies to the Ghallis and Zwejra landfills. The Industrial Emissions (Integrated Pollution Prevention and Control) Regulations, SL 549.77, require soil and groundwater monitoring where the activity involves the use, production or release of relevant hazardous substances and having regard to the possibility of soil and groundwater contamination at the site of the installation.

13.2. As mentioned, a Land and Groundwater Risk Assessment prepared for the MNWTP[58] had concluded that the risk to land and groundwater from the MNWTP was low and very low as a result of the planned mitigation measures, and therefore soil monitoring is not required. [59]

CURRENT PRACTICE

13.3. Five monitoring locations A to E are currently sampled; all the sampling points are located to the west of the Ghallis landfill, with point D being the furthest away (circa 220 m from the Ghallis site boundary).

13.4. Two samples of soil are taken at each location: one from the top 15 cm, and one at around 30 to 40 cm depth. Cereal crops are also sampled.

MONITORING PROGRAMME

13.5. There are no major run-off routes beyond the site boundary as a result of the surface water management system.

13.6. The location of the monitoring points for soil and crops is being revised as shown in **Figure 13.1**, to include better coverage of agricultural land in the immediate vicinity of both landfills, as follows:

- point C has been maintained, whereas points B and E have been removed as they are very close to this location;
- point F, to the northwest of Ghallis (and therefore upwind of the predominant wind direction), is included instead of point A. Cereal crops are planted at this location;
- point G, to the southeast of Zwejra (downwind of the predominant wind direction) has been added. Cereal crops are not planted at this location, however, other fields in the immediate vicinity of the Zwejra landfill are not cultivated; and

[58] Adi Associates Environmental Consultants Ltd, 2022. *Malta North Waste Treatment Plant. Land and Groundwater Risk Assessment.* San Ġwann, September 2022; iv + 28 pp. + 2 Appendices.
[59] Adi Associates Environmental Consultants Ltd, 2022. Malta North Waste Treatment Plant. Baseline Land & Groundwater Monitoring Report. San Gwann, September 2022; iv + 36 pp.

- the background monitoring point (D) has been removed due to its distance and direction from the landfills. If background data is needed in future, data from the previous years can be used. It is noted that exceedances of soil reference values have been observed at this location in the past (notably for cadmium, lead, zinc, tin, cyanide and PCBs).

13.7. The proposed monitoring programme is summarised in **Table 13.1**. The parameters to be monitored and the monitoring frequency have been retained from the previously approved programme, due to the presence of new monitoring sites. It is proposed that the monitoring frequency would be reviewed after one year's data is collected. Additionally, in light of difficulties encountered in finding a Contractor who can meet the former limits of detection, the typical limits of detection have been reviewed.

Table 13.1: Agriculture and soils monitoring

Monitoring points: C, F, and G					
Parameters	**Frequency**	**Typical detection limit**		**Soil contamination reference values[60]**	
		Soil	**Crops**	**Residential / public (green) use, mg/kg (dry)**	**Industrial / commercial use, mg/kg (dry)**
Nitrogen	Quarterly	100 mg/kg (0.01% m/v)	300 mg/kg	-	-
Phosphorous	Quarterly	20 mg/kg	20 mg/kg	-	-
Potassium	Quarterly	30 mg/kg	30 mg/kg	-	-
Mercury	Quarterly	0.3 mg/kg	0.01 mg/kg	1	5
Cadmium	Quarterly	0.6 mg/kg	0.01 mg/kg	2	15
Lead	Quarterly	1 mg/kg	0.05 mg/kg	100	1,000
Nickel	Quarterly	1 mg/kg	1 mg/kg	120	500
Arsenic	Quarterly	1 mg/kg	0.1 mg/kg	20	50
Chromium	Quarterly	1 mg/kg	0.1 mg/kg	150	800
Copper	Quarterly	1 mg/kg	1 mg/kg	120	600
Zinc	Quarterly	1 mg/kg	0.1 mg/kg	150	1,500

[60] Current limits applied by the ERA for contamination analyses are as per Italian Decreto 152 of 3rd April 2006

Monitoring points: C, F, and G					
Parameters	**Frequency**	**Typical detection limit**		**Soil contamination reference values[60]**	
		Soil	**Crops**	**Residential / public (green) use, mg/kg (dry)**	**Industrial / commercial use, mg/kg (dry)**
Tin	Quarterly	1 mg/kg	0.2 mg/kg	1	350
Boron	Quarterly	1 mg/kg	1.5 mg/kg	-	-
Fluoride	Quarterly	1 mg/kg	10 mg/kg	-	-
Sulphates	Quarterly	100 mg/kg (0.01% m/v)	20 mg/kg	-	-
Cyanides	Annual	1 mg/kg	1 mg/kg	1	100
PCBs (SUM)	Annual	0.005 mg/kg (individual PCBs)	0.001 mg/kg	0.06	5
PAHs (SUM)	Quarterly	0.05 mg/kg (individual PAHs)	0.05 mg/kg	10	100
Benzo(a)anthracene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.5	10
Benzo(a)pyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10
Benzo(b)fluoranthene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.5	10
Benzo(k)fluoranthene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.5	10
Benzo(g,h,i)perylene[61]	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10
Chrysene	Quarterly	0.05 mg/kg	0.05 mg/kg	5	10
Dibenzo(a,e)pyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10
Dibenzo(a,l)pyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10
Dibenzo(a,i)pyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10
Dibenzo(a,h)pyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10
Dibenzo(a,h)anthrancene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	10

[61] Benzo(g,h,i)terylene

Monitoring points: C, F, and G					
Parameters	**Frequency**	**Typical detection limit**		**Soil contamination reference values[60]**	
		Soil	**Crops**	**Residential / public (green) use, mg/kg (dry)**	**Industrial / commercial use, mg/kg (dry)**
Indenopyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	0.1	5
Pyrene	Quarterly	0.05 mg/kg	0.05 mg/kg	5	50
Naphthalene[62]	Quarterly	0.05 mg/kg	0.05 mg/kg	5	50
Dioxins and furans	Annual	10 ng/kg (Sum PCDD, PCDT)	0.001 µg/kg	0.00001	0.0001

13.8. Two samples of soil are to be taken at each location; one from the top 15 cm of the soils profile and one from between 30 and 40 cm (where soil depth permits). This will provide an indication of "recently" accumulated contaminants and accumulated contaminants leached through the soil. Sampling procedures will follow the ISO 10381 series of guidelines.

13.9. It is recommended that cereal crops continue to be used where possible as the agricultural product for sampling as they represent the predominant crop type and are likely to enter the food chain either directly by human consumption or as fodder for livestock as they are economically the most important crop in the area in terms of land use. Choosing one crop type consistently also minimises the variables in plant uptake that might influence results and hamper the identification in trends that would be more likely to occur if sticking rigidly to a sample location or agricultural plot with, for instance, different vegetable crops, including fruits, roots or tubers. Nevertheless, if cereal crops are not found at point G, it is proposed to sample the crops that are planted rather than not take a sample.

13.10. ERA is now applying Italian reference values for soil; the reference values for soil contamination are included in **Table 13.1**. It is noted that such reference values are typically used as screening values to determine the need for further assessment; therefore if any of the values are exceeded this would not necessarily translate to a significant risk to human health or the environment.

13.11. No Control or Trigger levels are proposed for crops at this stage. It is, however,

[62] Limits as per Italian decreto: ID152 of 2006. Part 4, Attachment 5, table 1 (non-listed on ERA current limits applied for contamination analyses, but tested as per Adi Associates Environmental Consultants Ltd, 2022. Malta North Waste Treatment Plant. Baseline Land & Groundwater Monitoring Report. San Gwann, August 2022; iv + 34 pp).

recommended that the data be reviewed annually to identify trends, not only in the values of contaminants in soils and cereals, but also in their spatial distribution, taking into account weather conditions, in particular winds and rainfall patterns, and other potential sources of contaminants such as the Maghtab landfill.

CONTINGENCY PLAN

13.12. If an exceedance of residential / industrial soil contamination reference values is noted, the following protocol will be adopted:

- Historical data will be reviewed (at this and other nearby locations and / or the former location D, as appropriate), to establish whether the exceedance is already existing;
- If the exceedance is new, the site management and ERA will be advised;
- A review will be carried out of air and leachate monitoring data to establish if there is a potential link between trends in air / leachate quality and soil quality. This will include consideration of the distance and direction of the monitoring points from the landfills and consideration of whether they are upwind / upstream or downwind / downstream of the landfills. Crop monitoring data will also be reviewed to determine whether there is a trend of increasing levels of the affected parameter in the crops;
- In the event that there is no apparent relationship between air / leachate quality and soil quality, a review will be carried out of land-use and activities between the landfill boundary and affected sampling point to identify whether external sources of the contaminant(s), such as agricultural runoff or the former Maghtab dump, could have affected the sample;
- In the event that no external source of contaminant(s) is identified, a review of site operations will be undertaken and appropriate actions identified and taken to avoid further increases; and
- The concentration of the affected parameters will be reviewed again at the subsequent monitoring session. If an increasing trend is noted that is attributable to the Ghallis / Zwejra landfills, further action may need to be taken, and the frequency of monitoring may need to be increased.

13.13. If a review of crop monitoring data reveals a trend of increasing concentrations of any parameter, the following protocol will be adopted:

- Historical data will be reviewed (at this and other nearby locations and / or the former location D, as appropriate), to verify whether there is a trend of increasing concentrations, or whether the increase is within the normal fluctuations of the parameter;
- If a trend is confirmed, the site management and ERA will be advised;

- A review will be carried out of air, leachate and soil monitoring data to establish if there is a potential link between trends in air / leachate / soil quality and crop concentrations. This will include consideration of the distance and direction of the monitoring points from the landfills and consideration of whether they are upwind / upstream or downwind / downstream of the landfills;

- In the event that there is no apparent relationship between air / leachate / soil quality and crop concentrations, a review will be carried out of land-use and activities between the landfill boundary and affected sampling point to identify whether external sources of the contaminant(s), such as agricultural runoff or the former Maghtab dump, could have affected the sample;

- In the event that no external source of contaminant(s) is identified, a review of site operations will be undertaken and appropriate actions identified and taken to avoid further increases; and

- The concentration of the affected parameters will be reviewed again at the subsequent monitoring session. If an increasing trend is noted that is attributable to the Ghallis / Zwejra landfills, further action may need to be taken, and the frequency of monitoring may need to be increased.

Figure 13.1: Agriculture and soils monitoring points

INDICATIVE ONLY - Not to be used for direct interpretation

Soil and crops monitoring points

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- Soil and crops monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 8 / 2018

14. NOISE

CURRENT PRACTICE

14.1. In accordance with the previously approved noise monitoring programme, monitoring was carried out annually at noise-sensitive receptor N1, a residential receptor. A noise study carried out in 2014[63] had identified this residence as being the only one requiring monitoring, to ensure that noise generated by the landfills does not change to the detriment of the sensitive receptor; having regard to the operations at Ghallis and Zwejra at that time, only day time monitoring was required.

14.2. The 2014 study had scoped out future surveys at the former noise monitoring points N2, N3, and N4, as the study revealed that extraneous noise at these locations effectively masked noise generated by the operations at the Ghallis / Zwejra landfills. However, and since the MNWTP has since been commissioned, a further noise study was undertaken in 2018[64] to assess the combined impact of the three sites on all four receptors. The 2018 study was carried out in accordance with an ERA-approved method statement[65]. Further analysis of the results of the 2018 noise study was undertaken in June 2019[66], as discussed and agreed with ERA.

14.3. The noise monitoring locations subject of the 2018 noise study are shown in **Figure 14.1** and described below; both day-time and night-time surveys were undertaken; the further analysis undertaken in 2019 concerned the results of the noise surveys undertaken at MP1 and MP2.

- MP1 (formerly N1): A residence to the west of Ghallis landfill;
- MP2 (N2): A residence to the east of Ghallis and Zwejra landfills;
- MP3 (N3): A residence to the south of Ghallis and Zwejra landfills; and
- MP4 (N4): Coastline hotel to the west of Ghallis landfill.

14.4. The following conclusions can be drawn from the 2018 / 2019 noise study:

- The study suggests that noise arising from the sites' operations during the night at MPs 2, 3 and 4 is in compliance with the conditions of the IPPC permits applicable at the time, and is unlikely to be having a significant adverse impact on the

[63] Adi Associates Environmental Consultants Ltd, 2014. *Non-Hazardous Engineered Waste Landfills at Ghallis and Ta' Zwejra: Noise Monitoring Report – 2014.* San Gwann, June 2014; vi + 18 pp. + 5 Appendices.
[64] Adi Associates Environmental Consultants Ltd, 2018. *Noise Monitoring Programme for Magħtab Environmental Complex. Report of Noise Survey*. San Gwann, May 2018; vi + 26 pp and 2 Appendices.
[65] Adi Associates Environmental Consultants Ltd, 2018. *Noise Monitoring Programme for Magħtab Environmental Complex. Method Statement*. San Gwann, January 2018; v + 13 pp.
[66] Adi Associates Environmental Consultants Ltd, 2019. *Noise Monitoring Programme for Magħtab Environmental Complex. Addendum to Report of Noise Survey*. San Gwann, June 2019; v + 5 pp.

sensitive receptors at these four locations.

- The study suggests that noise arising from the sites' operations during the night at MP1 is not in compliance with the conditions of the IPPC permits applicable at the time, but that it is unlikely to be having a significant adverse impact on the sensitive receptors at MP 1. The context of the noise surveys conducted at night-time at MP 1 (two surveys), was that noise arising from the site was not significantly audible, even though the wind was blowing directly from the site towards the MP. The noise assessors observed that noise audible from the site when there was no extraneous noise[67] was in the range of only 33 dB.

- The study suggests that noise arising from the sites' operations during the day time as measured at MP1 and MP4 is in compliance with the conditions of the IPPC permits applicable at the time, and is unlikely to be having a significant adverse impact on the sensitive receptors at these locations.

- In the case of MP2 and MP3, the operational noise levels recorded during the day time are not in compliance with the conditions of the IPPC permits applicable at the time. The assessors identified the high ambient noise levels at these monitoring points to be the result of passing traffic, and specifically the movement of rubbish trucks / skips to and from the Maghtab Environmental Complex.

MONITORING PROGRAMME

14.5. The following monitoring programme is recommended, based on the conclusions of the 2018 / 2019 study:

- Annual monitoring and reporting of the noise climate during the day and at night time at MP1 is appropriate, considering that MP1 is the closest sensitive receptor to the three sites.

- Monitoring and reporting of the ambient noise levels during the night at MP2 and MP3 is not necessary. Noise levels recorded at MP2 and MP3 during the night were compliant with the conditions of the IPPC permits applicable at the time, and the assessors observed only very limited noise arising from the Maghtab Environmental Complex at these locations during the night. Once the MRF facility becomes operational the noise levels will be re-assessed and the noise monitoring regime shall be updated accordingly.

- Annual monitoring and reporting of day time noise levels at MP2 and MP3 is appropriate, in order to gauge the changes in the ambient noise levels at these sensitive receptors.

- In the case of MP4, it is recommended that further monitoring and reporting of

[67] Extraneous noise is defined as noise arising from sources outside of the site and not in connection with activity related to the site.

the ambient noise levels during the day and at night is not necessary. Noise levels recorded at MP 4 during the day and at night were compliant with the conditions of the IPPC permits applicable at the time, and the assessors observed no audible noises arising from the sites at night at MP4 and only very distant noises during the day. Again, following the start of operations at the MRF, the noise monitoring regime shall be updated as necessary.

14.6. Monitoring is to be carried out in accordance with BS 4142:2014, and using a type 1 sound level meter.

14.7. Measurements are to be conducted having regard to the activity schedules of the Maghtab Environmental Complex.

14.8. Diagnostic measurements shall be taken once the MRF is in operation. Where diagnostic monitoring is considered appropriate, this should be carried out in accordance with ISO 1996 and BS4142:2014.

14.9. In the review of the 2018 / 2019 noise study, ERA suggested that "it would be good practice to include weekend monitoring in view that operations at Ta' Zwejra and at MEC are carried out also during the weekend", where the noise surveys had been conducted during the week. The need for weekend monitoring had been considered when scoping the 2018 study. At that time, it had been decided to scope out weekend monitoring with the view that activity levels at the site did not change on the weekend, and that there was unlikely to be a significant change in the background noise levels on the weekend from during the week. However, and taking account of ERA's suggestion, it has been agreed to re-scope the need for weekend noise surveys at the time of undertaking the next round of noise monitoring. This is particularly relevant because of the addition of the MRF.

14.10. **Table 14.1** presents a summary of the current noise monitoring programme. This table will be updated following the assessment which will be carried out at a later stage once the MRF is in operation.

Table 14.1: Summary of noise monitoring programme

Monitoring point	Timing	Frequency
MP1	Day and night (weekday)	Annual
MP2, MP3	Day (weekday)	Annual
MP1	Day and night (weekend)	One-time survey, following which the need for further weekend monitoring will be evaluated
MP2, MP3	Day and night (weekend)	One-time survey, following which the need for further weekend monitoring will be evaluated

CONTINGENCY PLAN

14.11. The following protocol is recommended should any exceedances of the noise levels defined in the IPPC permits be measured:

- The site management will be advised.
- The source of the high noise levels will be identified through the observations made by the assessors. This will include consideration of whether any abnormal site activities were underway during the monitoring.
- If it results that activities on site could have caused the exceedance, the Operator will, in consultation with ERA, identify additional mitigation measures to reduce noise emissions from the site.
- Noise monitoring will be repeated once these additional mitigation measures are in place.

Figure 14.1: Location of noise monitoring points

INDICATIVE ONLY - Not to be used for direct interpretation

Adi ASSOCIATES

Noise monitoring points

Legend

- Għallis Landfill
- Malta North Waste Treatment Facility
- Ta' Żwejra Landfill
- Noise monitoring points

Environmental Monitoring Programme for the Maghtab Environmental Complex

Map by: Adi Associates Environmental Consultants Ltd

Client: Wasteserv Malta	Ref: WSM029
Client: Env. Monitor.\Maghtab Env. Comp.	Date: 8 / 2018

Appendix 1: Priority Trace Components in Landfill Gas

Detailed gas composition	Priority trace components
Methane[68]	*Aromatic hydrocarbons:* Benzene, toluene, xylene, styrene
Carbon monoxide[69]	Sum dioxins & furans (PCDD/PCDF), expressed in TEQ
Carbon dioxide	*Mercaptans*: Methanethiol, ethanethiol, 1-butanethiol, 1-propanethiol
Oxygen	*Other organosulphur compounds:* Carbon disulphide
Hydrogen sulphide	*Halogenated organic compounds*: 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, chloroethane, chloroethene (vinyl chloride), dichloromethane, dimethyl disulphide, dimethyl sulphide, tetrachloromethane, trichloroethene
Hydrogen	*Aliphatic hydrocarbons*: 1,3-butadiene, 1-pentene
	Alcohols: 2-butoxyethanol
	Butyric acid
	Aldehydes: Methanal (formaldehyde), ethanal (acetaldehyde)
	Ethyl butyrate
	Furan (1,4-epoxy-1,3-butadiene) (CAS: 110-00-9)
	Metals: Arsenic, mercury

[68] This is checked on site before sampling. If the methane content is less than 30% (that is, more than 50% diluted), the sampling point may be unsuitable for assessment and an alternative point more representative of raw, undiluted gas should be found.

[69] Carbon monoxide concentrations greater than 100 ppmv (field measurement) or 25 ppmv (verified in the laboratory) may be indications of abnormal data, for instance due to interference by hydrogen (such as may be generated by fresh waste) and hydrogen sulphide in field measurements, or due to a deep-seated fire within the landfill.

Appendix 2: Sampling Strategy for Monitoring from Biofilters

INTRODUCTION

1. The European Standard EN 13284-1:2017 describes a gravimetric method for monitoring low-range dust concentrations from stationary sources. It is applicable to ducted gaseous streams in concentrations below 50 mg/m^3 at standard conditions. This standard was primarily developed and validated for gaseous streams emitted by waste incinerators, but it can be applied to gases emitted from other stationary sources, and to higher concentrations.

2. This standard is recommended by Commission Implementing Decision (EU) 2018/1147 establishing BAT conclusions for waste treatment as the reference method for monitoring of dust emissions. However, this method requires sampling under isokinetic conditions, where sampling is carried out at the velocity (and direction) as the gaseous effluent in the chimney. Since the biofilters are open and do not include a chimney, a sampling strategy adapted from EN 13284-1:2017 will be used, as described below.

3. It is noted that the use of the EN 12341: 2014 method is not recommended since, in addition to having been designed for ambient air monitoring, it requires sampling at a constant flow (2.3 m^3/h). This velocity is greater than the velocity of the biofilter emissions, and would result in an underestimation of the emissions, since the sample taken would be richer in lighter particles.

4. Personnel involved in the sample collection need to have received training on this methodology (in-house training is acceptable) and have proven experience in similar work (or be supervised by someone who has such experience). Proof of such training and experience is to be provided as part of the tendering process. Competence is to be ascertained prior to the actual monitoring taking place. Additionally, the laboratory analysis is to be undertaken at a laboratory certified to at least the ISO/IEC 17025 standard.

PROCEDURE

5. Each monitoring campaign will consist of three phases:

   - Mapping of the air velocity from the top of the biofilter bed;
   - Choice of sampling points; and
   - Sampling of the gaseous effluents.

Air Velocity Mapping

6. Before proceeding with sampling it is necessary to check the presence of flow and the absence of preferential flows by checking the velocity values, through the use of an accelerator fumehood (**Figure 1**) and an anemometer (with a resolution of 0.1 m/s); these parameters are to be checked on suitable areas identified according to the below-described criteria.

Figure 1: Example of an accelerator fumehood

7. The biofilters consist of a single module with an emission surface of 33 x 15 m (PS7) and 16 x 11 m (PS8). The entire surface of the biofilter will therefore be preliminarily divided into three equal areas (A, B and C). Each of these three areas will be divided into four sub-areas (A1, A2, A3, A4; B1, etc.). The velocity measurement will be undertaken in the centre of each sub-area. The value will then be noted for the 12 points.

Choice of Sampling Points

8. Once the velocity map on the biofilter bed has been acquired, the sampling points will be selected according to the subarea in each area where the highest velocity values has been determined. Therefore, three samples per session will be performed for the entire biofilter bed (e.g. at A1, B3, and C2).

9. Sampling will be carried out at the centre of the identified subarea.

10. The choice of sampling in the sub-areas where the maximum velocity is measured represents a precautionary choice since it theoretically identifies the worst conditions of filtration, because a higher velocity represents a shorter contact time of the air to be treated with the biofilter material.

Sampling of Gaseous Effluents

11. Sampling will be carried out using an accelerator fumehood (**Figure 1**), at the three points identified previously (i.e. three points per biofilter).

12. The measurement of flow rate will be carried out according to the standard reference method EN ISO 16911-1, which applies to steady-state flows, i.e. flows characterised by substantially constant velocity, density, temperature and pressure.

13. The principle of determination of velocity requires taking differential pressure measurements (by means of a Pitot tube) or determining the velocity by vane anemometry. A Pitot tube provides a means to determine the differential pressure within a region of the measurement plane.

14. It is proposed to use a 1m^2 square-based fume hood in stainless steel with an accelerator chimney having an outlet diameter of 150 mm. The pyramid trunk of the hood must have a height of about 740 mm and an apothem of approximately 856 mm. A metal cylinder 1,650 mm high will be positioned above the pyramid trunk and at a distance of 1,200 mm from the base of the cylinder, the sampling point will be created consisting of a standard flange having a diameter of 10 cm. Each pick-up point must be equipped with a metal screw closure.

15. The sampling and determination of dust will be carried out in accordance with the EN 13284-1 method. If it is possible to sample under isokinetic conditions, the maintenance of isokinetic conditions shall be guaranteed automatically by continuous or small interval gas velocity measurements carried out by the sampling flow management system integrated in the sampling pump. If the conditions for sampling under isokinetic conditions cannot be achieved, constant flow sampling (at the minimum flow recommended by the method, about 1 m^3/h) will be used.

16. In accordance with the BAT conclusions, samples of at least 30 minutes each (i.e. per sub-area) are to be taken.

REPORTING

17. The measurement report should provide a comprehensive account of the measurements, a description of the measurement objective and the measurement plan. It should provide sufficient detail to enable the results to be traced back through the calculations to the collected basic data and process operating conditions.

18. Test results should be provided at the following standard conditions: dry gas at a temperature of 273.15 K and a pressure of 101.3 kPa, without correction for oxygen content, and expressed in mg/Nm^3, in accordance with the BAT conclusions.

19. The results of the three monitoring points from each biofilter are to be expressed as an average, in accordance with the BAT conclusions.

Appendix 3: Screening List

Parameter	Groundwater reference value[70] (µg/L)	Environmental quality standard for coastal waters (µg/L)[71]		Ideal limit of quantification (coastal waters)[72] (µg/L)
		Annual average	Maximum allowable concentration	
Organic aromatic solvents				
Benzene	1	8	50	2.4
Ethyl benzene	50			
Styrene	25			
Toluene	15			
Para-xylene	10			
Polycyclic aromatic hydrocarbons				
Acenaphthene				
Acenaphthylene				
Anthracene		0.1	0.1	0.03
Benzo(a)anthracene	0.1			
Benzo(a)pyrene	0.01	1.7×10^{-4}	0.027	0.51×10^{-4}
Benzo(b)fluoranthene	0.1		0.017	
Benzo(g,h,i)perylene	0.01		8.2×10^{-4}	
Benzo(k)fluoranthene	0.05		0.017	
Chrysene	5			
Dibenzo(a,h)anthracene	0.01			
Fluoranthene		0.0063	0.12	0.00189
Fluorene				
Indeno (1,2,3-c,d) pyrene	0.1			
Naphthalene		2	130	0.6
Phenanthrene				
Pyrene	50			

[70] Carlon, C. (Ed.) (2007). *Derivation methods of soil screening values in Europe. A review and evaluation of national procedures towards harmonization,* Annex 3 (Italy).
[71] Water Policy Framework Regulations (S.L. 549.100).
[72] This has been set at 30% of the AA-EQS, to be met to the extent possible.

Parameter	Groundwater reference value[70] (µg/L)	Environmental quality standard for coastal waters (µg/L)[71]		Ideal limit of quantification (coastal waters)[72] (µg/L)
		Annual average	Maximum allowable concentration	
Carcinogenic chlorinated aliphatic compounds				
Chloromethane	1.5			
Trichloromethane	0.15	2.5		0.75
Vinyl chloride	0.5			
1,2-Dichloroethane	3	10		3
1,1-Dichloroethylene	0.05			
1,2-Dichloropropane	0.15			
1,1,2-Trichloroethane	0.2			
Trichloroethylene	1.5	10		3
1,2,3-Trichloropropane	0.001			
1,1,2,2-Tetrachloroethane	0.05			
Tetrachloroethylene (perchloroethylene)	1.1	10		3
Hexachlorobutadiene	0.15		0.6	0.18
Sum of aliphatic chlorinated compounds	10			
Carcinogenic halogenated aliphatic compounds				
Tribromomethane (bromoform)	0.3			
1,2-Dibromoethane	0.001			
Dibromochloromethane	0.13			
Bromodichloromethane	0.17			
C10-C13 chloroalkanes		0.4	1.4	0.12
Phthalates				
DEHP (di(2-ethylhexyl)-phthalate		1.3		0.39

For Screening List parameters, the limit of detection is to be at least the groundwater reference value / coastal water annual average EQS, as far as possible.

Appendix 4: Authorisation Letters (Groundwater Monitoring Boreholes)

WASTESERV
CREATING RESOURCES FROM WASTE

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Authorisation letter

In line with its obligations, Wasteserv monitors its operations and also the surrounding environment in which it operates. In order to facilitate the necessary environmental monitoring, Wasteserv is kindly asking for access to the below mentioned borehole for routine water sampling.

As the registered owner of Borehole 3308, situated at the Maghtab Shooting Range in *Triq ir-Ramla*, I hereby authorise WasteServ Malta Ltd. to access and use the aforementioned borehole for the purpose of collecting groundwater samples once every three (3) months, or as otherwise agreed with ERA.

In order to facilitate and ensure adequate sampling the borehole including associated equipment such as pumps and pipework shall be kept in good working order.

No reimbursement shall be issued by WasteServ Malta Ltd. for the collection of groundwater.

Alex B. Vettiger

Name in Block Letters

Signature

26-02-2020

Date

Done in English in two originals: one for WasteServ Malta Ltd. and one for the Borehole Owner

WASTESERV
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Authorisation letter

In line with its obligations, Wasteserv monitors its operations and also the surrounding environment in which it operates. In order to facilitate the necessary environmental monitoring, Wasteserv is kindly asking for access to the below mentioned borehole for routine water sampling.

As the registered owner of Borehole 2130, situated in *Trejqet l-Irziezet*, I hereby authorise WasteServ Malta Ltd. to access and use the aforementioned borehole for the purpose of collecting groundwater samples once every three (3) months, or as otherwise agreed with ERA.

In order to facilitate and ensure adequate sampling the borehole including associated equipment such as pumps and pipework shall be kept in good working order.

No reimbursement shall be issued by WasteServ Malta Ltd. for the collection of groundwater.

Frans Dalli

Name in Block Letters

Frans Dalli

Signature

08/05/2020

Date

Done in English in two originals: one for WasteServ Malta Ltd. and one for the Borehole Owner