D2.1 BASELINE MONITORING PROTOCOLS

Alchemia-nova

April 30, 2023

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		UPV/EHU, UPWR	
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ACRONYMS

ALCN – ALCHEMIA-NOVA

G!E - GREENOVATE ! EUROPE

KTH - KUNGLIGA TEKNISKA HOEGSKOLAN

MS - MICROSOFT

THAMES - THAMES21 LIMITED

UPV/EHU – UNIVERSIDAD DEL PAIS VASCO/ EUSKAL HERRIKO UNIBERTSITATEA

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UPWr - UNIWERSYTET PRZYRODNICZY WE PL WROCLAWIU

UBRUNEL - BRUNEL UNIVERSITY LONDON

WP – WORK PACKAGE

EXECUTIVE SUMMARY

SYMBIOREM's main innovation is introducing viable, sustainable, and circular bioremediation systems targeting soil, seawater, surface water, groundwater, and sediment contamination. The broad innovation potential of SYMBIOREM consists of various technologies that can be combined in train or tandem and applied to different contaminated environments. Twelve cutting-edge technological solutions in bioaugmentation, biostimulation, microbial, enzyme, nano, and phyo-technologies are developed at the lab scale. Some are tested at the field scale in nine field sites.

Polluted sites will be restored for agriculture, recreation, or business purposes, and valuable resources will be recovered. SYMBIOREM elaborates new avenues for circular value creation and empowers people by involving citizens in participatory research, co-design and co-management of bioremediation sites, reduces knowledge inequalities, increases biodiversity and mitigates climate change by reducing greenhouse gas emissions and sequestering carbon. This deliverable describes the methodology used to collect data and monitor the SYMBIOREM technological solutions installed at the nine field sites. A description of the sites' characteristics, data collection plan, and timeframe are provided. The deliverable also includes a preliminary definition of the comparability criteria between the sites. Comparability between sites is required for the risk and benefit assessment of the technologies tested and developed in SYMBIOREM (WP5 and WP6). Since it will not be possible to statistically compare sites because of their specific environmental, geographical, and socio-economic differences, a few standard criteria for comparability are identified, data collected at the nine demos sites will be incorporated into the LCAs developed by WP6 and used to plan a transferability study. Similarly, the performance assessment and economic validity (WP5) will be partly based on the data collected at each site. Indicators used for the performance assessment pertain to resources used, level of decontamination, and ecosystem services gained (e.g., increased biodiversity).

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1 Introduction

SYMBIOREM develops viable, sustainable, circular bioremediation systems targeting soil, seawater, groundwater, and sediment contamination. Twelve cutting-edge technological solutions in bioaugmentation, biostimulation, microbial, enzyme, nano, and phyo-technologies are developed at the lab scale, and some are tested at the field scale. SYMBIOREM integrates environmental, social, regulatory, and economic assessment with feedback loops to technology development to ensure sustainability, circularity, and cost-efficiency. This deliverable describes the technological solutions' monitoring and baseline data collection plan. A description of how the data and monitoring plan feeds into the analysis of the comparability, transferability, and performance assessment is provided in section 3.

Section 2 of this deliverable describes the methodology used to collect data and monitor the SYMBIOREM technological solutions installed at the field sites. The field sites are polluted sites that will be restored for agriculture, recreation or business and recovery of valuable resources. A description of the characteristics of each site, the responsible partners, the type of contamination, and the type of SYMBIOREM technological solutions installed at the site is provided in section 2.1. The researchers responsible for the technical solution at each field site have developed a data collection plan.

In SYMBIOREM, the technological solutions are tested on the site, and data collection and monitoring are conducted by researchers in cooperation with the citizens, some of whom live near and around the site. SYMBIOREM aims to empower people by involving citizens in participatory research, co-design and co-management of the remediated sites.

The data collection plan described in this deliverable includes some indicators of the involvement of citizens as well. However, a more comprehensive analysis of citizens' participation and cooperation in the co-design of solutions, data collection, data analysis and education activities will be provided in D2.2.

SYMBIOREM targets five archetypes of contaminated environments: Brownfield soil, mixed solid waste landfill, urban diffuse pollution of surface water bodies, agricultural drainage, and marine sediments.

Industrial brownfield: Brownfield sites derive from the economic transformation from industrial to service-based economies in Europe, which has left behind the cessation of numerous industries. These sites are now brownfields contaminated with hydrocarbons, PAHs (e.g., benzo(a)pyrene), heavy metals (e.g., zinc, lead, arsenic, mercury) and sulfate sulfur, often sources of contamination of the terrestrial ecosystems and leaching to groundwater unsuitable for agriculture and posing health threats to surrounding inhabitants. This archetype is represented in SYMBIOREM by three project sites: a broken fuel oil tank buried in an old foundry in Azkoitia, Spain; a former glass industry site in lower Austria; and Wroclaw Osobowice irrigation fields in Poland.

Mixed solid waste landfill: Landfills can contaminate nearby terrestrial and aquatic ecosystems. Risks of leaching pesticides, solvents, hydrocarbons and metals into adjacent soil and groundwater can become an additional environmental hazard. Landfill leachate will be collected from Austria's municipal mixed solid waste landfill. The dilution factors and potential hazard reduction will be tested in a plant-microbes-substrate vertical system for treatment. Indigenous hydrocarbon-degrading microorganisms will be isolated from the site and used for bioaugmentation via encapsulation and adding amendments. The best-performing conditions for biodegradation will be scaled up in a larger biopile test with a substrate from a landfill in Bizkaia (Spain).

Urban diffuse pollution of surface water bodies: Mixed contamination from road runoff (oils, heavy metals, microplastics), sewer misconnections and combined sewer overflow (harmful bacteria, organic micropollutants and their toxic metabolic products), as well as eutrophication, cause degraded freshwater ecosystems and adverse human health impacts also from growth of undesirable organisms (e.g., cyanobacteria) and toxic emissions (Müller et al., 2020). Nature-based solutions have been found to perform well in treating mixed contamination. Innovative solutions are needed in settings where traditional river restoration techniques are not applicable in efforts to achieve Water Framework Directive objectives. These archetypes are represented by the Thamesmead site (London, UK) and an urban reservoir in a park in Wroclaw (Poland).

Agricultural drainage: Diffuse pollution with excess nutrients and resulting eutrophication, rapid biomass degradation and sediment buildup is targeted at Lake Neusiedl (Austria). Sediment and silt are also issues at Thamesmead. Salinization of agricultural land and reuse of saline drainage water is targeted in Central Valley, California (USA). Salinization is one of the main threats confronting soils in the EU (Montanarella & Rusco, 2008).

Marine sediments: All European seas are struggling with large-scale contamination, and there is an urgent need to reverse the degradation of coastal ecosystems. Further, with its low salinity, the Baltic Sea provides insights into coastal and freshwater bodies, such as sediment treatment and application as a soil amendment. Hence the Baltic Sea, with high nutrient and metals contamination, was selected as a target context.

The 12 technologies developed in SYMBIOREM are bio-based, using selected microorganisms, microbiomes, enzymes, fungi, plants, and aquatic animals. The bio-based technological solutions are modular solutions that can work in symbiosis to mutually enhance bioremediation efficiency, use secondary inputs as much as possible, and turn residues and contaminants into valuable resources. SYMBIOREM incorporates circularity strategies by investigating recoverable resources, such as remediated land and water, clean soil, nutrients and metals, and substrates/soils.

Comparing technological solutions amongst sites is unsuitable given the diversity of contamination (source and type of contaminants, concentrations), the climatic and environmental conditions, and the adaptation of each technological solution to the site-specific characteristics, including the results of the co-design and co-development with citizens. Instead, we identify a set of parameters that can be used to compare technological solutions' environmental, economic, and social impacts. This part on comparability is described in Section 3. Common indicators between sites in the same archetype of contamination (i.e., soil, seawater, agricultural drainage) will be used to create the base for comparability amongst sites (see section 3).

The data collected from each site will provide the basis for the transferability of technological solutions to other sites and at a larger scale. These data will be incorporated in the LCAs developed by WP6 and used to plan a transferability study (Section 4). Similarly, the performance assessment and economic validity (WP5) will be partly based on the data collected at each site. Indicators used for the performance assessment pertain to resources used, level of decontamination, and ecosystem services gained (e.g., increased biodiversity).

A technical guidance document for collaborative, safe, and inclusive bioremediation technologies will be developed in T2.3. The guidance document will combine technical measures with community participation and education. Safety refers to preventing and avoiding exposure to contaminants by wildlife and humans and avoiding transferring pollutants from one compartment of the ecosystem to another. In this respect, monitoring wildlife behaviour (feeding/nesting patterns), contamination occurrence, and transport (soil and water at critical points where leaching/drifting/erosion can occur) is conducted. These monitoring strategies will be an integral part of the guidance document. Local citizens co-design and co-manage nature-based bioremediation solutions developed in SYMBIOREM while collaborating to establish safety measures. Engagement measures include awareness raising and education of citizens through their engagement in co-design and management/maintenance of nature-based technologies. A risk assessment and mitigation strategy will be developed for each site.

2 Data Collection Plan

2.1 Description of sites

The location of nine field sites where the 12 technological solutions for bioremediation will be tested is shown in *Figure 1*

Figure 1. Map of the location of the sites.

Three of the nine sites (Azkoitia in Spain, Wroclaw Osobowice irrigation fields in Poland, and Lower Austria) will implement remediation technologies on brownfield soils. Bio-nano remediation will be implemented on a mixed solid waste landfill in Bizkaia in Spain. Bioaugmentation and biostimulation will remediate sediment and water collected from the Baltic Sea.
A floating island with an extended surface with immobilised microorganisms will be installed at the city pond in Stanislaw Tolpa park, Poland. In contrast, a floating wetland enhanced with mussels will be installed at the lake in Gallion's Lake, UK, and Lake Neusiedl, Austria. Figure 2 summarizes the remediation technologies.

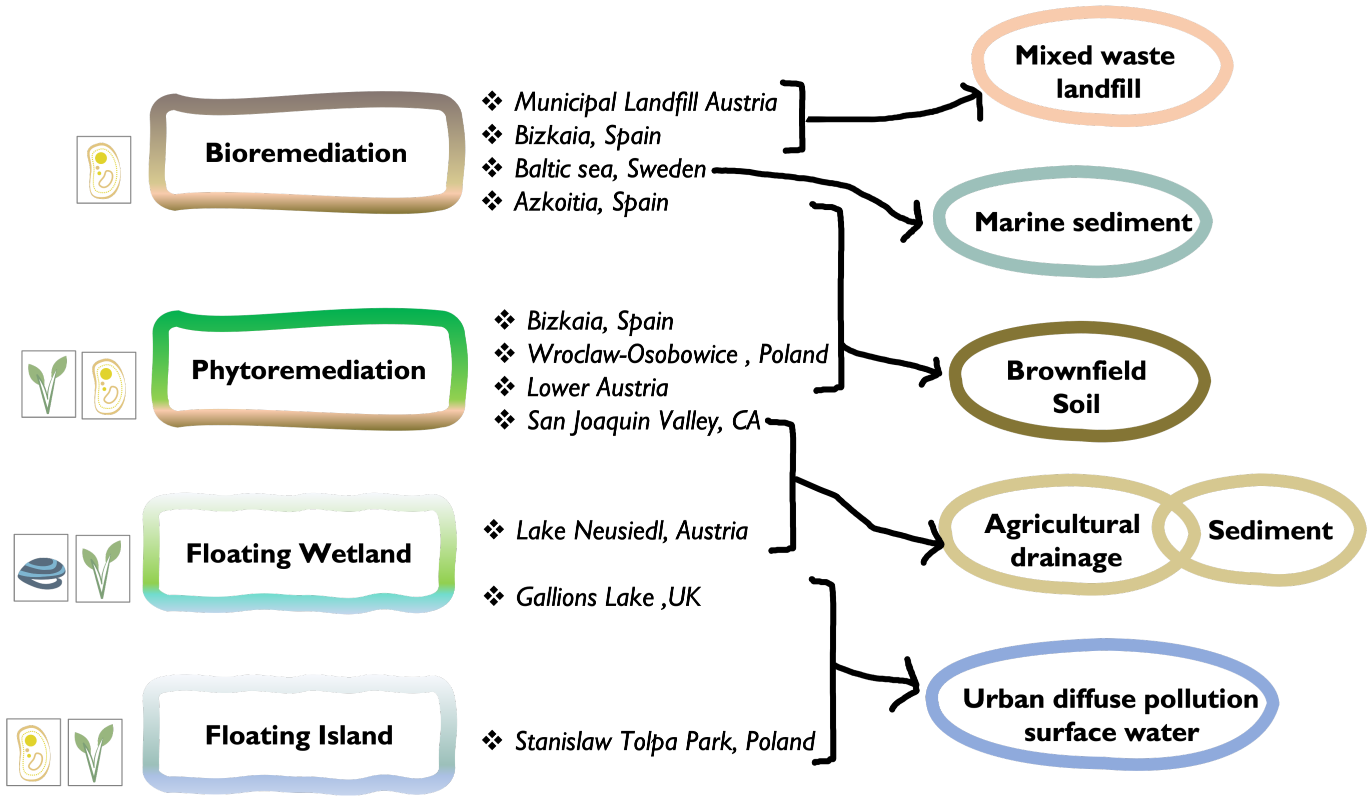

Figure 2. Schematic representation of the bioremediation technologies used at each site for the remediation of the archetypes of contaminated environments.

A description of the characteristics of the site and the technologies implemented at each location are provided in the following section. The sections are organised by archetypes of contaminated environments.

Archetype Brownfield Soil

Table 1. Archetype Brownfield soils, characteristics of the sites.

SITE NAME	ARCHETYPE	SITE LEAD	CONTAMINATION	TECHNOLOGY	ANALYSED MEDIA
Azkoitia (Spain)	Brownfield	GAIKER	PAH, HC	Bioremediation: biostimulation/ bioaugmentation	Soil
Wroclaw Osobowice irrigation fields (Poland)	Brownfield	UPWR	HM, HC	Phytoremediation	Soil
Lower Austria (Austria)	Brownfield	ALCN	PAH, HC, HM	Phytoremediation and electro culture	Soil

2.1.1 Azkotia (Spain)

Over the past half-century, industrial advancements have left many contaminated sites and polluted soils with high levels of organic compounds and heavy metals.

Restoring and regeneration of these brownfields in a sustainable way for beneficial uses is an essential priority for society. Bioremediation is considered a safe, economic, efficient and sustainable technology for the remediation contaminated soils.

Bioremediation is defined as a process in which organic contaminants are degraded by microorganisms and, hopefully, become mineralised so that, eventually, they become nontoxic compounds. The bioremediation treatment could be approached by two main strategies to enhance the remediation of the target contaminants: biostimulation and bioaugmentation.

The first one is based on the stimulation of the natural degrading abilities of native microbial populations through supplying optimum levels of nutrients (nitrogen, phosphorus) or amendments (compost) and adjusting environmental conditions like moisture or oxygen.

The second strategy is based on inoculating exogenous microorganisms (one strain or a consortium of different themes) with the ability to degrade the target contaminants. However, these exogenous microorganisms compete for energy and nutrients with the autochthonous microbial communities and frequently undergo high mortality due to abiotic and biotic stresses.

A common drawback for successfully applying both strategies is the difficulty of a homogeneous dispersion of the amendments or of these new strains throughout the entire soil matrix.

The field site used for this experiment is an old bronze foundry brownfield close to an urban area in Azkoitia. The site is near the Urola River, and the land is stratified, from bottom to top, in the rocky firm, stones, alluvial terrain and concrete.

After conducting different exploration studies, an old fuel oil tank buried (*Figure 3*) under the concrete was detected. The tank was dug up, but the soil surrounding this area presented hydrocarbon contamination due to leaks. This soil has been excavated and analysed, showing a total hydrocarbon content of around 1000 mg/kg.

Figure 3. Image of fuel oil tank after digging it up and the excavation of the hydrocarbon-contaminated soil

The bioremediations experiments will be performed in big pots, testing different biostimulation conditions to activate and enhance the autochthonous hydrocarbons degrading microorganisms. Once the best degrading conditions have been defined, the nutrients will be dosed encapsulated in nanocarriers, and the improvement in soil remediation will be compared.

Moreover, the best autochthonous degrader strains isolated and identified (task 3.1) will be grown in a batch bioreactor. These bacteria will be encapsulated as nanocarriers dosed on the soil, and the bioaugmentation treatment will be evaluated.

2.1.2 Wroclaw Osobowice (Poland)

Wroclaw Osobowice irrigation fields served as a natural sewage treatment plant of the Wroclaw for over a hundred years. The beginning of the exploitation of the fields dates back to year 1880. The irrigated area, in the beginning, was about 560 ha. In subsequent years, the fields were systematically expanded almost to 1300 ha (Łyczko, 2018). After the Janowek Sewage Treatment Plant start-up, the share of irrigated fields in the sewage treatment process has been systematically decreased in terms of the amount of sewage and the flooded area. The field's exploitation was finished in 2013.

As a result of the nearly 130 years long functioning of fields treated with large wastewater loading, the soil underwent marked transformation and accumulated various compounds and elements, especially: organic matter, nitrogen, phosphorus, and heavy metals (Czyżyk, 2014).

The object of study is located in the north part of Wroclaw, on the Wroclaw Plain – between rivers Odra and Widawa (

Figure 4). This experiment area is situated in a warm, moderate-climate zone and covered with alluvial soils. These are mainly brown muds (in the upper layers made of clay, primarily light and medium, lined at a depth of 50–100 cm with sand or gravel) and, in lower layers, sandy muds (made of light loam sands, light loamy and firm loam sands, lined at a depth of 50–100 cm with loose sands and rarely clays) (Kajewska-Szkudlarek & Łyczko, 2021).

Figure 4. Location of the research area - Wroclaw-Osobowice irrigation fields

The results of heavy metals concentration in soil samples collected from different locations in 2022 and 2023 are presented in Table 2. Zinc and cadmium are dominant contaminants present in the soil.

Table 2. The concentration of heavy metals in the soil of Wroclaw-Osobowice irrigation fields [mg/kg dry soil]

	ZINC	CUPPER	CADMIUM	LEAD	CROMIUM	NICKEL
Number of samples	35	35	31	28	32	35
MIN	39.60	2.42	0.05	3.27	3.38	3.74
MAX	1093.51	677.09	45.45	296.83	234.98	126.39
Permissible limit	300	100	2	100	150	100
Number of exceeded	15	7	17	8	2	1

The heavy metals from the soil in the Wroclaw-Osobowice irrigation field will be phytoextracted in laboratory and field tests. Specialised active water-absorbing geocomposite (WAG) system using fungi and yeast will support uptake of contaminants by the plants. WAG will consist of fibres and other sustainable materials and provide water and nutrients, resulting in increased biomass production. Energy crops like Miscanthus giganteus, and others such as willow, oxy tree or hemp will be co-tested for phytoremediation. The best performing species will be tested for adaptive laboratory evolution with increasing concentrations of the pollutant to improve their natural properties for bioremediation. The best nutrient composition for the consortia of microorganisms and plants will be developed and tested in the field experiment.

2.1.3 Lower Austria

The site is located in Lower Austria, and the contamination derives from a former glass production plant. The old site covers an area of about 90,000 m^2 (Figure 5). Various types of glass, such as lead crystal, bottles of all kinds, apothecary glass, ink glasses, milk bottles, siphons, etc., were produced at the old site. In addition to the glass production facilities, the old site housed gasworks, neutralization sludge basins and an industrial landfill. Soil contamination was determined by analysis of soil samples and eluates in 2013. Groundwater concentration of PAHs and heavy metals is regularly analyzed via sampling from fixed water wells installed at specific locations at the site. No threat of groundwater contamination has been found. According to the Austrian criteria for the priority classification, priority three results for the old site require the site to be monitored for contaminant movement in the ecosystem and eventually remediated. The primary pollutants are lead, arsenic, and tar oil-specific pollutants (PAH, phenols).

This study will collect the highly contaminated soil to conduct a pot experiment under controlled conditions. The soil will be amended with organic contaminants (compost, biochar, aged manure) to increase the absorption of the organic pollutants and the metals into the soil matrix, and hyperaccumulators and native plants will be grown in the pots to enhance uptake and degradation of the organic contaminants with the root-associated microbial community. In addition, electro-culture will be applied to the pots (Briggs, 1926; Electro-Culture, 1900). The phytoremediation experiments will be conducted under controlled conditions where wires connect metallic aigrettes, so cultivating plants under a network of wires will channel the

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electromagnetic currents to enhance plant growth and microbial degradation potential. This has not been tested before and is an innovative project aspect.

The contaminants of the soil at the site include As (20-120 mg/kg), Ba (70-2500 mg/kg), Pb (60-2500 mg/kg) and Cd (1-18 mg/kg). In addition, PAHs have been measured and found in the concentration of 0,3-4,1 mg/kg; however, a characterization of the US EPA priority 16 PAHs needs to be conducted to identify the PAHs of major concern.

Figure 5. Site in Lower Austria.

Archetype Mixed solid waste landfill

Table 3. Archetype mixed solid waste landfill, characteristics of the sites.

SITE NAME	ARCHETYPE	SITE LEAD	CONTAMINATION	TECHNOLOGY	ANALYSED MEDIA
Bizkaia (Spain)	Landfill	EHU	PAH, HC, HM	Biopile bionanoremediation	Soil
Barakaldo (Spain)	Brownfield	EHU	HM, HC	Bioremediation and phytoremediation	Soil
Landfill leachate (Austria)	Landfill leachate	ALCN	Nutrients, HM	Vertical NBS treatment	Landfill leachate

2.1.4 Bizkaia (Spain)

The soil is located in an old landfill with a significant presence of lindane. Currently, the landfill is closed and has a wooded area and abundant vegetation. It is an optimal clay soil for a mixed process of nano bioremediation.

In the absence of an exhaustive examination and mapping of the contamination of the area (in the process). Preliminary numbers indicate that a nano remediation process combined with bioremediation may be necessary to reduce contaminants early and improve final bioremediation.

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2.1.5 Barakaldo (Spain)

The soil to be remedied is located in an abandoned industrial area that wants to be converted into urban gardens. The initial analyses indicated contamination in PAHs, HC and small amounts of heavy metals.

The soil will be remediated through bioremediation techniques (biopile) and phytoremediation. The bioremediation process will be improved by adding nanoparticles with nutrients to enhance the remediation.

2.1.6 Landfill leachate (Austria)

ALCN will test and adapt its vertECO® treatment wetland system in a lab-scale experimental setup (experiment site: 48.1946° N, 16.2763° E) with different configurations of substrates and vegetation for efficient treatment of leachate from mixed solid waste landfills. Three mini-vertECO setups will be built, one control (without vegetation) and two other mini-vertECO systems planted with different vegetation. Substrates and plants will be selected based on the results of previous ALCN projects, literature, and sorption experiments tested in real leachate.

The leachate will be collected from a closed domestic waste landfill in Langenlois, Krems, Lower Austria, Austria. The landfill operated from 1974 – 2004 with untreated domestic waste. Since 2004 only inert wastes are allowed to be disposed of on this site. The Landfill spans an area of about 15 ha and the daily receipt of residual waste corresponds to about 80-100 tons per day. The approximate composition of the waste is as follows: wood ashes or fly ashes from other combustion plants (70%), other contaminated soils (15%), artificial mineral fiber (approx. 15%). The chemical composition of landfill leachate is presented in (Table 4), these data were provided by the company managing the landfill.

The type of experiments that will be conducted include, a) sorption experiments to identify the best substrate to be used in the mini-vertECO systems; b) laboratory scale prototypes of vertECO composed of different substrates in each stage and different types of vegetations or without vegetation at all (control). Influent and effluent wastewater samples will be monitored for nutrient (N forms; PO_4-P or Ptot; Chl; pH; electrical conductivity, temperature, COD or BOD, TSS) and selected heavy metals (e.g., Cr, As, Ni, Pb, Fe). Landfill leachate composition shows high contents of salt concentration, we think to use halophytes as potential plants to be tested in 2 pilots and one control mini-vertECO systems.

Table 4. Landfill leachate composition (2022) which will be treated using mini-vertECO systems at ALCN.

PARAMETER	VALUE
pH	8.0
Electrical conductivity (µS/cm)	25000
Ammonium (as NH_4) (mg/L)	2100
Ammonium (as N) (mg/L)	1600
Chloride (as Cl) (mg/L)	2920
Sulphate (as SO_4) (mg/L)	186
Carbonates (as HCO_3) (mg/L)	12800

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Natrium (as Na) (mg/L)	3050
Kalium (as K) (mg/L)	2310
Aluminum (as Al) (mg/L)	2.1
Chrom (as Cr) (mg/L)	0.41
Arsen (As) (mg/L)	0.042
Nickel (Ni) (mg/L)	0.57
Lead (as Pb) (mg/L)	0.15
Iron (as Fe) (mg/L)	10.4
Copper (as Cu) (mg/L)	0.23

The treatment of the landfill leachate using a vertical wall system, is expected to be a combined outcome of substrate, plants (phytoremediation) and micro-organism community (bioremediation) interactions.

Urban Diffuse Pollution of surface water bodies

Table 5. Urban diffuse pollution of surface water bodies, characteristics of the sites.

SITE NAME	ARCHETYPE	SITE LEAD	CONTAMINATION	TECHNOLOGY	ANALYSED MEDIA
Wroclaw (Poland)	Urban diffuse pollution to surface water	UPWR	Nutrients, HM, microplastics	Floating island with microorganisms	Water and sediments
Thamesmead (UK)	Urban diffuse pollution to surface water	Thames21	Nutrients, HM, HC	Floating treatment wetlands enhanced with mussels	Water and sediments

2.1.7 Wroclaw City Pond (Poland)

The demonstration site in Wrocław is located in the city park - Stanisław Tołpa Park, in the center of the city (location: 51°07′12″N 17°03′10″E). Urban water reservoir, which is the biggest attraction of the park, is the remnant of the Odra River branch. Its area is about 0.48 ha, and the average depth is 1.4 m (Figure 6). Due to its location in the city center, the place between large, busy streets (Stanisława Wyszyńskiego, Nowowiejska and Bolesława Prusa streets), the pond is exposed to a constant inflow of pollutants.

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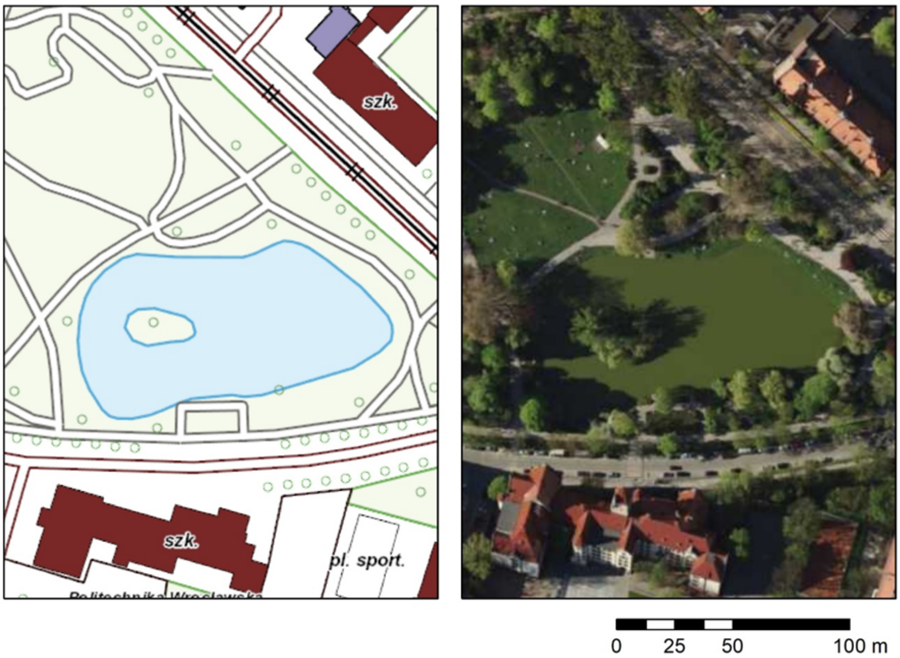

Figure 6. Location of the park Pond in the Stanisław Tołpa Park.

The bottom of the tank is naturally sealed with hardly permeable formations and lined with foil. The pond's shore is reinforced with stone with a slope of 1:2, which gives the reservoir a regulated character. The pond's water source is mainly surface runoff and precipitation, which makes it particularly vulnerable to linear pollution related to increased car traffic in its immediate vicinity. Due to the lack of inflow from other sources, water exchange in the pond practically does not occur. An additional factor that negatively affects the water quality in the reservoir is its exposure to sunlight, which makes the pond particularly susceptible to the eutrophication process. Aeration devices are periodically installed in the pond (spring and summer) to limit the adverse effects of pollutant inflow. The reservoir is an enclave for many species of water birds.

Water for physicochemical analyses is taken once a month into sealed tanks made of polyethylene terephthalate with a capacity of 1.5 L. Transport of samples takes place less than 2 hours from the moment of their collection. Tests of water samples are made at the Laboratory of Environmental Research of the University of Environmental and Life Sciences in Wrocław (Table 6). Water quality tests include determining the content of organic matter expressed by BOD5, COD and TOC, total suspended solids, nitrogen forms (nitrites, nitrates, ammonia nitrogen), total phosphorus, phosphates, heavy metals as well as pH, conductivity, and chlorophyll a concentration.

Considering the closed character of the pond in Stanisław Tołpa Park changes in parameters are limited, and their standard deviation is relatively small.

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Table 6. Tests of water samples of the park Pond in the Stanisław Tołpa Park

PARAMETER	UNIT	MEAN	MIN	MAX	STANDARD DEVIATION
Ammonia Nitrogen NH_4	mg/dm^3	0.2019	0.0197	0.3758	0.17
Nitrites NO_2	mg/dm^3	0.0042	0.0032	0.0063	0.001
Nitrates NO_3	mg/dm^3	0.1316	0.0638	0.1930	0.05
Organic nitrogen	mg/dm^3	15.19	6.49	30.63	10.66
Total nitrogen	mg/dm^3	15.95	7.54	31.01	10.3
Total phosphorus	mgP/dm^3	0.756	0.553	0.883	0.17
Phosphates	mgP/dm^3	0.0215	0.000	0.100	0.037
BOD_5	mg/dm^3	13.9	11.9	16.9	2.65
COD	mg/dm^3	223.67	212.00	241.10	15.38
TOC	mg/dm^3	80.88	74.80	87.30	5.66
pH	-	7.35	7.27	7.72	0.16
Conductivity	µS/cm	679.29	599.00	751.00	69.75
Turbidity	NTU	99.75	79.00	116.00	16.09
Dissolved oxygen	mg/dm^3	13.28	12.60	13.60	0.45
Total suspended solids	mg	127.5	109.0	168.0	27.3

The primary nitrogen source in Tołpa pond is organic nitrogen, which is over 95 % of the total nitrogen in tested samples from the pond, with a mean value of 15.19 mg/dm^3. Due to the pond's location in the city park, higher variations in concentrations of organic nitrogen are in order, as the pond's shore is highly covered with trees. The mean value of ammonium nitrogen is 0.20 mg/dm3, the mean value of nitrites is 0.0042 mg/dm^3, and the mean value of nitrates is 0.13 mg/dm^3. Nitrogen ratios are characteristic of pH levels observed in the pond, with a mean pH value of 7.35. A similar case can be seen with phosphorus; over 97% of phosphorus in Tołpa pond is organic, with a mean value of 0.756 mg/dm3 (total phosphorus). Phosphates, which represent inorganic phosphorus (mainly occurring) in samples, have a mean value of 0.0215 mgP/dm^3. BOD5, COD and TOC represent organic compounds in samples. The mean values of parameters are as follows 13.9 mg/dm^3, 223.67 mg/dm^3 and 80.88 mg/dm^3. Due to high eutrophication (algae growth) in the pond and hydrated light sludge on the pond's floor, high concentrations of total suspended solids (TSS) and turbidity can be seen.

For the same reason, a higher standard deviation has been reported. The mean TSS value is 127.5 mg, mean turbidity value is 99.75 NTU. The mean conductivity value is 679.29 µS/cm, corresponding with high eutrophication rates in the pond as it corresponds with overall pond pollution. During daytime the pond is rich in oxygen, with a mean concentration of 13.28 mg/ dm^3.

2.1.8 Thamesmead (UK)Table 7Figure 7Figure 8

Thamesmead, located 18km east of central London (51.499593, 0.108040) in the Royal Borough of Greenwich and the London Borough of Bexley comprises mainly social housing built on reclaimed Thames marshlands in the 1960s. The area was drained, and the water consigned into a complex network of artificial canals and lakes, including Gallions Lake, to protect the local residences from flooding. These drain directly to the Thames estuary via several sluices.

According to the Indices of Deprivation 2019 (https://dclgapps.communities.gov.uk/imd/iod_index.html#) Thamesmead is within the 10% most deprived areas of the country and experiences multiple issues around low income, low employment, health deprivation, high crime and vandalism, graffiti and gangs. The existing damp, low quality housing is currently being demolished in a huge billion-pound gentrification and house building programme in Thamesmead led by the Peabody Trust, a non-profit housing association. This scheme comprises provision of new, better quality social housing, creation of over 20,000 new homes, improved infrastructure and transport connections and landscaping to improve water quality and amenity value of the area.

Generally, the canals in Thamesmead are concrete lined with the lakes having concrete banks (with the occasional small sections of natural banks) with a wide shelf around the edges and a natural bottom. Gallions Lake averages 0.7m in depth is joined to a section of the canal that is closed at one end. The bankside has a mix of features, including reed, concrete banks and tow boarding. It is a popular venue for anglers with a very active fishing club, however, the lake suffers from silt buildup and regular road runoff and raw sewage pollution from the surrounding residential areas, which have led to fish kills in the past. A nearby bus garage is suspected to be causing oil slicks to enter the lake. According to the UK regulatory authority the Environment Agency, urban diffuse pollution from road runoff and inputs of raw sewage from misconnected properties are both reasons for “not achieving good status” in this catchment and a road run-off risk modelling project, led by Thames21 that assesses London’s strategic road network has identified several roads in the highest pollution risk category that drain into Galloons Lake via the surface water sewer network (https://www.thames21.org.uk/improving-rivers/road-run-off/).

In autumn 2023, floating wetlands for water treatment will be installed as part of the wider urban regeneration project, after which a floating wetland with mussel mesocosms will be added. The water quality will be tested pre and post installation of the floating wetlands as well as when the mussels are added to the lake. Results from previous water sampling in 2021 and 2022 carried out by site owner Peabody can be seen in Table 7 and a summary of results taken over a 6-week period in 2023 part of the SymBioRem project be seen in Figure 7 and Figure 8.

The recent sampling was carried out on the following dates listed below at 5 locations around the lake.

- *Sample 1 = 25th January 2023*
- *Sample 2 = 3rd February 2023*
- *Sample 3 = 8th February 2023*
- *Sample 4 = 15th February 2023*
- *Sample 5 = 24th February 2023*
- *Sample = 28th February 2023*

Table 7: Pollutant concentrations taken from Gallions Lake in 2021 and 2022 by Peabody.

PARAMETERS	UNITS	2021			2022		
		Min	Max	Median	Min	Max	Median
Total Coliforms	MPN/100ml	5,800	29,090	17,445	1986	>241,960	84,342
Escherichia Coli	MPN/100ml	67	313	190	387	>241,960	81,102
Chlorophyceae	Cells/L	150,000	91,000,000	23,162,500	Not detected	1,258,000	999,000

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Bacillariophyceae	Cells/L	100,000	140,000,000	29,872,000	Not detected	32,000,000	259,160,00
Planktothrix	Cells/L	Not detected	2,440,000	2,440,000	Not detected	Not detected	Not detected
Microcystis	Cells/L	37,000	37,000	37,000			
Salmonella Spp	per 1L	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
Salmonella - Volume Tested	ml				300	1,000	600
Intestinal enterococci	CFU/100ml	2	18	10	30	>10,000	3,396
Temperature	°C	11.2	24.2	19	12.5	22.1	19
pH	pH Unit	8.3	8.4	8.35	8.1	8.4	8
Electrical Conductivity @ 20°C	µS/cm	1,300	1,900	1,600	1,600	2,600	2,200
Total Dissolved Solids - Meter	mg/l	900	1,400	1,150	1,100	1,700	1,566
Suspended Solids @ 105°C	mg/l	41	73	57	11	98	55.6
Heavy Solids		Absent	Low		Absent	Absent	
Biochemical Oxygen Demand	mg/l	12	30	21	7.3	19	11.3
Chemical Oxygen Demand	mg/l	61	89	75	46	100	72.3
Dissolved Oxygen	mg/l	15	17	16	3.7	14	10
Oxygen Saturation	%	170	200	185	42	150	100.6
Total Kjeldahl Nitrogen as N	mg/l		11		2.5	2.7	2.56
Ammoniacal Nitrogen as N	mg/l	0.15	0.53	0.34	0.15	0.44	0.246
Nitrate as NO3	mg/l	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
Nitrite as NO2	mg/l	<0.03	<0.03	<0.03	<0.03	0.99	0.35
Chloride	mg/l	170	380	275	190	670	486.6
Copper, Total	mg/l	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Zinc, Total	mg/l	0.015	0.023	0.019	0.013	0.049	0.027
Lead, Total	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium, Total	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel, Total	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Manganese, Total	mg/l	0.2	0.18	0.19	0.18	0.32	0.24
Cadmium, Total	mg/l	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Mercury, Total	mg/l	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Arsenic, Total	mg/l	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phosphorus, Total	mg/l	0.49	0.97	0.73	0.48	0.82	0.66
Anionic Surfactants	mg/l	<0.05	<0.05	<0.05	<0.05	0.31	0.19
Cyanide, Total	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Phenols, Total	mg/l	0.18	0.33	0.255	<0.10	0.58	0.26

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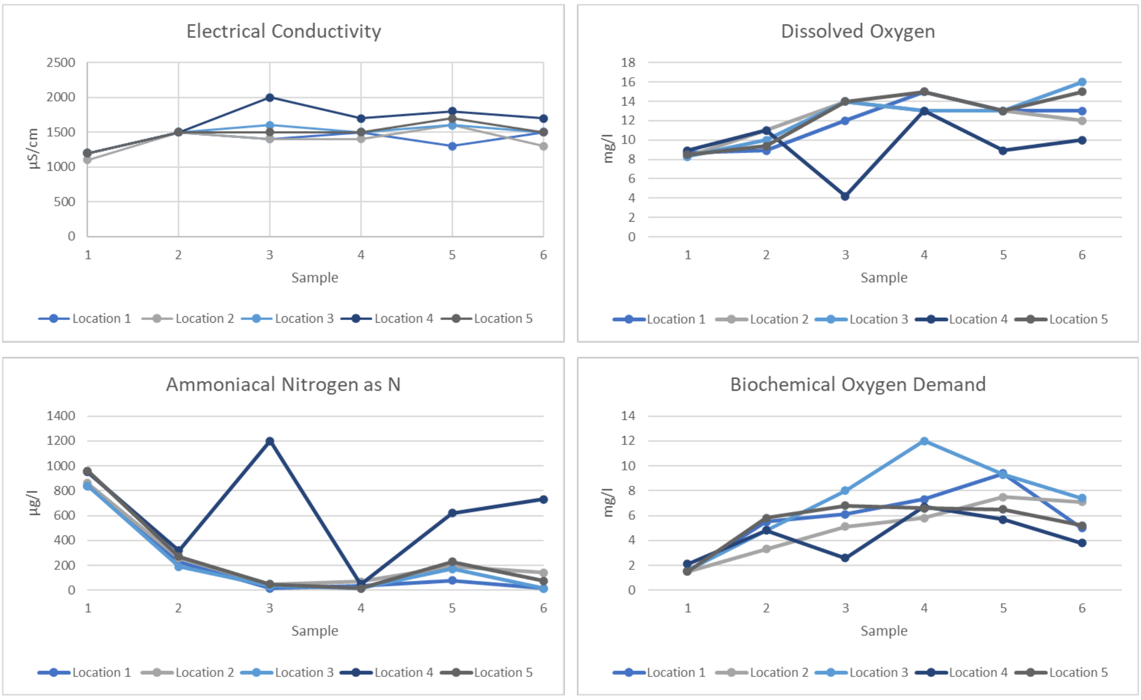

Figure 7: Concentration of general inorganics detected at Gallions Lake, Thamesmead, UK.

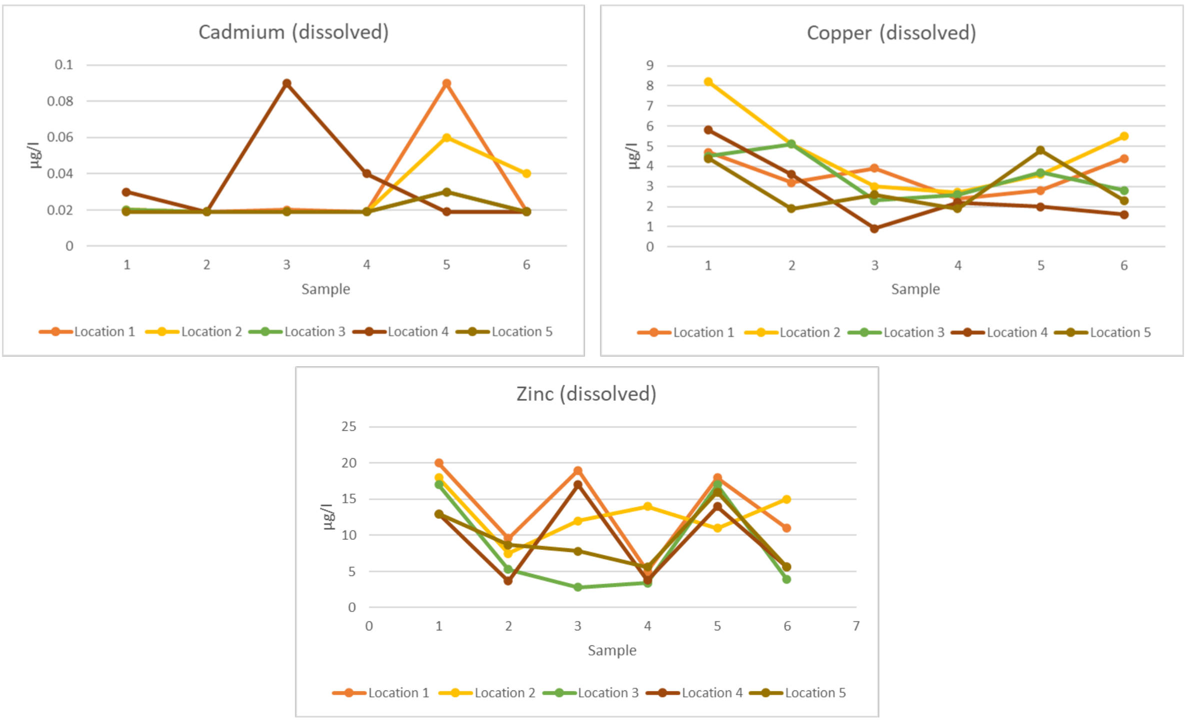

Figure 8: Concentrations of heavy metals detected at Gallions Lake, Thamesmead, UK.

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Agricultural drainage

Table 8. Agricultural drainage, characteristics of the sites.

SITE NAME	ARCHETYPE	SITE LEAD	CONTAMINATION	TECHNOLOGY	ANALYSED MEDIA
Lake Neusiedl (Austria)	Drainage water and sediment	ALCN/EZY	Nutrients, HM, microplastics	Floating treatment wetlands enhanced with mussels	Water and sediments
Central Valley California (USA)	Drainage water and sediment	CSUF	Nutrients, salts, Se	Phytoremediation	Soil and drainage water

2.1.9 Lake Neusiedl (Austria)

Lake Neusiedl is in the Burgenland region in Austria. The lake is a steppe lake characterized by mesotrophic to eutrophic shallow features. The lake has a low water volume due to low rainfall patterns and a longer dry season. The lake is at environmental risk of degradation caused by climate change and exacerbated by the absence of a natural outflow and excessive nutrient input. In recent years, improved wastewater treatment technologies have reduced the N and P loads of the inflows although all municipalities surrounding Lake Neusiedl (with one exception) and the cities and municipalities within the catchment area of the river Wulka discharge their (treated) wastewater into Lake Neusiedl (Kinner at al., 2013). The amount of wastewater in 2010 was more than 22 x 106 m^3. Although the amount of wastewater increased by more than 70% in the last 30 years, it was possible to reduce the ammonium load from 38 t/a to 8 t/a (as NH4-N), the nitrate load from 83 t/a to 34 t/a (as NO_3-N), the phosphate load from 8 t/a to 3 t/a (as PO_4-P) and the total phosphorus load from 11 t/a to 6 t/a (comparison of the average annual loads of 1982 and 2010) (Kinner at al., 2013). Another environmental risk for Lake Neusiedl is the nitrogen input due to agricultural activities. In this study, a floating wetland enhanced with freshwater mussels will be installed in the lake or in the location where the treated wastewater is discharged into the lake.

2.1.10 Central Valley, California (USA)

In arid regions of central California, high soil salinity, Se, and B, in conjunction with severe drought, are serious threats to irrigated agriculture (Centofanti and Bañuelos, 2015). The San Joaquin Valley is one of the greatest-producing agricultural regions of the world. This area's soil is mainly derived from Cretaceous shale rocks that contain naturally high salts and other trace elements like B and Se. Typical agronomic crops have a difficult time growing under these adverse growing conditions. If agricultural production is to continue to thrive in the SJV, there is a need to identify other alternative crops that are salt and drought tolerant. Not only is soil contamination a problem, but extreme water scarcity calls for utilizing non-conventional water sources. Researchers have demonstrated the saline ground waters or drainage water produced on the West side of Central California can be used successfully to grow selected crops that are salt- and B-tolerant. Guayule, a native plant in the southwestern United States and northern Mexico, may be a potential crop to consider. Due to guayule's potential significant commercial value in rubber production and its drought tolerance, guayule has been considered an alternative crop for arid and semi-arid areas of

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the southwestern United States, north-central Mexico, and other regions with similar arid climates throughout the world (Bañuelos at al., 2022).

In this study, poor quality clay-like saline soil high in Se and B was collected near Mendota, CA in 1999. Typically, soil salinity ranges from 8-14 dS/m, and soluble B and Se ranges from 8-13 mg B/L and 0.25-0.50 mg Se/L, respectively. The experiment will be performed in both saline and non-saline micro plots to (field-installed lysimeters) to evaluate different ecotypes of guayule (*Parthenium argentatum* A. Gray) (Figure 9) for their tolerance to irrigation with water containing, B and Se when grown in either saline and non-saline soils. Latex and rubber production will also be evaluated under the varied growing conditions.

Figure 9. Guayule plants grown on the sediment plot in the San Joaquin Valley, CA.

Marine Sediment

Table 9. Baltic Sea Stockholm Archipelago (Sweden), characteristics of the site.

SITE NAME	ARCHETYPE	CONTAMINATION	TECHNOLOGY	ANALYSED MEDIA
Baltic Sea (Sweden)	Marine sediment	Nutrients, HM, PAHs	Bioremediation, bioaugmentation, biostimulation	Sediments

The Baltic Sea is the largest inland brackish sea in the world that serves as food, income, and recreational area for around 85 million residents as well as being home for various living organisms. Currently, the Baltic Sea is under stress of serious contamination which resulted in having a bad reputation as “the most polluted sea in the world”. The Baltic Sea receives various pollutants such as nutrients (nitrogen and phosphorus), metals and organic contaminants through municipal and industrial wastewater discharges, agricultural runoff, and atmospheric deposition. Up to date, more than 97% of the Baltic Sea is affected by eutrophication. Currently, 826 tons of nitrogen and 30900 tons of phosphorus are introduced to the Baltic Sea and the total nitrogen and phosphorus input to the Baltic Sea was around 7% and 44% higher than the maximum available input in 2015, respectively (State of the Baltic Sea, 2018). Especially, phosphorus accumulation in the Baltic Sea is problematic since the phosphorus cycle does not have as significant an atmospheric component as nitrogen and cannot be fixed from the atmosphere (Paytan & McLaughlin, 2007) and phosphorus releases from the sediment under anoxic conditions which triggers eutrophication problem. The Baltic Sea is also highly polluted by heavy metals with concentrations up to 20 times higher than the North Atlantic (State of the Baltic Sea, 2018). According to a Swedish EPA monitoring study between 2003 and 2014, heavy metal content in sediments was assessed and classified as between I and V (from none-I or very insignificant-V to very large deviation from national background) according to environmental assessment criteria. In the Landsort deep which is close to Stockholm, Zinc (Zn), Copper (Cu), Cadmium (Cd), and Arsenic (As) showed Class IV- Class V quality. In the Northern Bothnian Bay, Arsenic (As) showed Class V quality and Cadmium (Cd), Copper (Cu), Cobalt (Co), Mercury (Hg), Nickel (Ni), and Zinc (Zn) have Class III quality. In Arkona Basin, Copper (Cu) and Zinc (Zn), have Class III quality and Lead (Pb) Class IV quality (Jönsson, 2011). This monitoring study showed high accumulation of metals in the Baltic Sea sediment. Organic contamination is also problematic for the Baltic Sea. In terms of PAH, the North Sea and the Southern Baltic are the most problematic areas for potentially toxic levels. In the Southern Baltic, the highest concentration was observed as around 3 mg/kg dw in 2008 (Josefsson, 2022).

Before the project started, sediment and water samples were collected from the Baltic Sea in 2020 for another project at two different points and characterized. The results are given in Table 10. Recently, further sediment sampling was done f (April 2023), which will also be characterized.

Table 10. Characteristics of Sea Water, Pore Water and Sediment (Baggensfjärden:B, Farstaviken, F) (the values are given as average)

PARAMETER	SEA WATER		PORE WATER	
	B	F	B	F
pH	7.3	7.4	n.a.	n.a.
PO_4-P (mg/l)	0.031	0.325	1.52	2.68
TP (mg PO_4-P/L)	0.053	0.403	1.90	3.6
TN (mg/L)	n.a.	n.a.	9.13	22.55
TOC (mg/L)	n.a.	n.a.	92.1	128.3
SO_4^{-2} (mM)	2.9	5.1	n.a.	n.a.
NH_4^+ (mM)	0.01	0.1	n.a.	n.a.
K^+(mM)	1.7	1.8	n.a.	n.a.
Ca^{2+}(mM)	7.4	7.4	n.a.	n.a.
	Sediment			
	B		F	
pH	7.0		7.1	
Total solids (g/L)	16.7		11.6	
Volatile solids (g/L)	2.17		1.8	
Total nitrogen (µgN/g)	4658.3		4708.3	
Total P (µgP/g)	1095.6		1224.7	
Organic P (µgP/g)	399		514.4	

In this study, a bio-based cascade strategy will be developed to bioremediate marine sediment for organic pollution and recovery of valuable raw materials. Firstly, marine sediment collected from the Baltic Sea will

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be remediated in batch bioreactors for treating polycyclic aromatic hydrocarbons (PAHs) by comparing the natural attenuation and biostimulation/bioaugmentation approach. Simultaneously, another batch of tests will be conducted to recover phosphorus and metals /metalloids from marine sediment via anaerobic fermentation/bioleaching strategies. In this part, a novel sequential recovery system, phosphorus recovery followed by metal/metalloid recovery, will be developed. Based on the best strategies obtained from the batch tests, a continuous bioreactor and recovery system will be developed and operated in the long term to provide PAH bioremediation, phosphors, and heavy metal recovery. After then, a pilot-scale reactor system will be designed using ASPEN for real-scale applications. Different management strategies (i.e., beneficial use) for the treated sediment will be also theoretically evaluated.

2.2 Type of data collected at each site.

The data collection spreadsheet is structured into 17 categories that characterize the type of information collected at each site. The list of categories used and the explanation of the meaning of each parameter is described in Table 11. The categories were defined by ALCN and then discussed and agreed upon by all the partners involved in T2.1.

Table 11. List of categories characterizing the data collected at each site and description of their meaning.

CATEGORIES	DESCRIPTION	DATA USAGE AND RELATION TO OTHER WPS
Site name and location	Name of the site and coordinates	For reference
Task number	Name the task this activity belongs to	For organizational purposes
Type of pollution	List of contaminants that occur at the site for which the remediation is conducted	To compare remediation methods with same type of contaminants
Type of remediation	Describe the type of remediation conducted, e.g., bioremediation, phytoremediation, etc.	To categorize the remediation strategies and use this data for WP5
TRL	Technology readiness level as described in DoA	For reference
Type of experiments conducted	List what type of experiments are conducted at the site and/or in the lab. This is explained in brief, but a complete description of the experimental design is attached in the appendix	To record information and potentially "compare" similar experimental procedures
Type of experimental control	Describe the experimental control. What does it consist of? Is it a nearby uncontaminated site, or is it a blank (no treatment)?	As a reference for further checks
List of parameters to be analyzed	List all the parameters that you intend to analyze in the experiment, including environmental parameters (air humidity, soil moisture, etc.). Include baseline parameters as well, if any.	To record data and potentially "compare" similar experimental procedures
Type of samples to be collected for analysis	List the type of samples (soil, soil solution, runoff water, biomass,	For data collection and analysis

	etc.) that you will collect for the experiment	
Location of sample collection	Indicate where the samples are collected at the site, you can use a map or coordinates.	As a reference for further checks
Methods of sample collection	List all the methods you use to collect samples	To record information and potentially "compare" similar experimental procedures
Methods of sample analysis	List the methods of sample analysis for each type of sample collected	For data collection and analysis
Frequency of sample collection and analysis	Indicate how often you will collect samples and analyze them within the duration of the study	For data collection and analysis and for organizational purposes
Estimation of one-time-use lab supplies used for the study	Indicate the amount (kg) of one-time use lab supplies (such as pipette tips, plastic bags, containers, gloves, etc.) that you will use to conduct the study	To make our study more conscious of waste and use the data for the circular tool and the business models (WP6)
Material inputs	List the type of materials utilized for the experiments (e.g., coconut fiber, carboard, metal, plastic, etc.)	To be used in the circularity assessment and in the LCA/business models (WP6)
Energy utilized	Indicate the type and amount (e.g., kWh) of energy used to conduct the experiment	To be used in the circularity assessment and in the LCA/business models (WP6)
Community data - activities	List the type of activities citizens will be involved with, i.e., attend an event, volunteer in data collection, lead a discussion forum.	To be used in the circularity assessment and in the LCA/business models (WP6)
Community data – time spent	Indicate the number of events attended and type of event attended	To be used in the circularity assessment and in the LCA/business models (WP6)

The data collected for each category at each site is reported in Appendix 1. The excel spreadsheet (appendix 1) is preliminary and will be updated throughout the development of D2.1, as T2.1 is ongoing and ends at M42. The data for some categories (estimation of one-time-use lab supplies) can only be known after the completion of the experiments. Each partner responsible for the field site (Section 2.1) filled in the list of parameters, types of samples, and methodology for the experiments and the tests to be carried out at the site. The experimental methods listed in this deliverable may be subject to adaptations based on the development of the technologies according to the site characteristics which is still under elaboration. The project develops eight remediation solutions: phytoremediation; bioremediation with freshwater mussels attached to a floating wetland; anaerobic bioreactor with natural attenuation; bioaugmentation; biostimulation; biopiling; cascade bioreactor; combined use of the floating island with an extended surface with immobilized microorganisms. This initial excel spreadsheet (Annex 1) will be further developed into a more extensive database where each field site has space to add data on recurrent sampling dates and for multiple parameters per sampling date.

2.3 Protocols for data collection

The data will be collected by each field site lead, as listed in Tables 1-5. Several consortium partners who are not site leaders will contribute to sample collection and analysis at several sites as described in the DoA. The partners and site leads will conduct sample laboratory analysis and data evaluation. The data collected will be shared amongst consortium partners via the shared MS Teams platform managed by EHU. Data repository and communication & dissemination will follow the guidelines in D1.3. ALCN, as task lead, will maintain close contact with site leads to monitor work progress, data collection and analysis. Regular meetings will be held with the site leads and the WP2, 3, and 4 leads to coordinate the efforts, increase the efficiency of the experimental work and sample analysis, and provide mitigation plans in case of unforeseen risks. Foreseen risks already listed in the DoA will be dealt with according to the developed mitigation plan. This coordination effort will provide the baseline analysis of comparisons of sites and technologies for developing modular bioremediation tools in WP5. Integrated solutions capable of removing multiple pollutants simultaneously to enhance bioremediation efficiency will be developed in WP5, T5.1. The best-performing approaches will be combined regarding the level of clean-up achieved, ecosystem services provided, and the status of citizens' engagement set concerning safety and awareness. New pathways for valorization will be evaluated in WP6.

The timeframe for data collection is reported in Figure 10. The timescale has been developed according to the Gantt chart of the project. As data collection and analysis is ongoing during the duration of the study at each site, the integration into WP5 and WP6 partly overlaps. WP5 and WP6 will plan their activities well before the commencement of data collection at all the sites. Still, the performance and evaluation of the technologies will be finalized when all the data at the sites are collected.

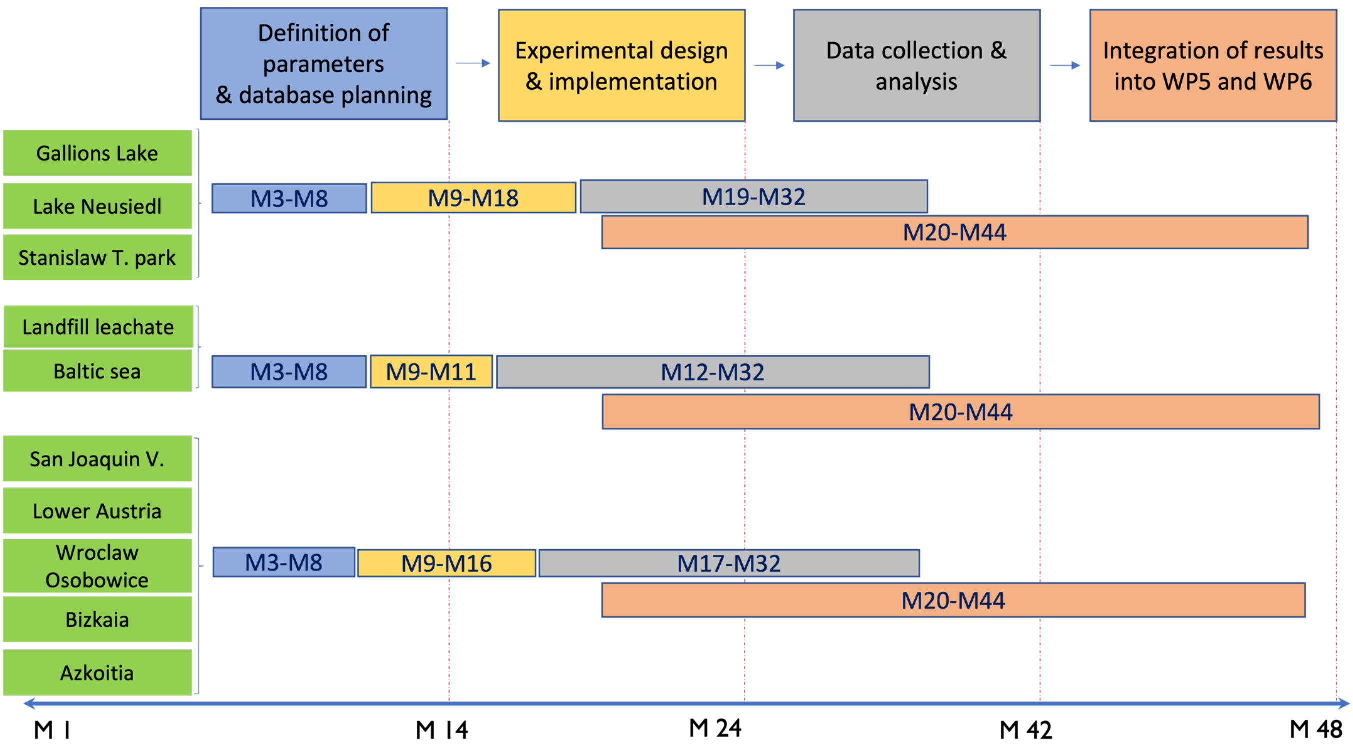

Figure 10. Timeframe for data collection plan, experiments' execution and integration of the data into WP5 WP6.

The participation of citizens in the experimental design of the technologies installed at the field sites and the citizens' involvement in the data collection, analysis and dissemination is developed in T2.2, T2.3, and T2.4 within WP2. An approach to mainstream citizens' engagement will be developed by Thames21, and the results of the engagement and the lessons learnt from it will be part of a guideline for collaborative,

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safe and inclusive bioremediation strategies, including educational material and activities. The excel spreadsheet (Annex 1) includes a collection of data about the type of engagement of citizens (e.g., event, volunteering, leading) and the time spent participating in the project. These categories will be further expanded as the project progresses and citizens' engagement occurs. At the time of writing this deliverable, the field sites are in the planning stage, where citizens are not yet involved.

3 Comparability, transferability, performance, and evaluation of the technologies

Comparability criteria will be based on standard parameters amongst the sites. Since it will not be possible to compare sites because of their specific environmental, geographical, and socio-economic differences, a few standard criteria for comparability will be identified. Parameters and monitoring schedules will be aligned to enable comparability and insight (understanding of generated data) by other partners.

The criteria for comparability suggested are the following:

- *Types of pollutants and types of technology (i.e., heavy metals, PAHs and bioremediation)*
- *Recovered nutrients (i.e., P)*
- *Ecosystem services produced (i.e., soil formation, waste treatment)*
- *Level of clean-up obtained (percentage of initial contamination)*

These criteria will be further revised during the project's duration and while the technologies are implemented at the sites and data is collected. The overall benefits obtained by the bioremediation solutions developed in SYMBIOREM will be evaluated in WP6. An integrated assessment of all the SYMBIOREM solutions will be developed in T6.4. The data collected (Annex 1) will provide the baseline for comparing technologies and selecting the best performing for developing modular bioremediation tools (WP5) efficient at removing multiple pollutants simultaneously to enhance bioremediation efficacy. Data obtained from the technologies installation at the sites described in this deliverable and collected in a database (Annex 1) will be used in WP5 and WP6. Data on material inputs, including laboratory one-time-use materials and energy utilized, will feed into the economic evaluation methodology. The data on pollutant removal and biodegradation levels achieved will be used for the environmental impact assessment. The transferability analysis economic, social, and environmental impact assessment methodology will be developed in WP5 and WP6. Data on citizens' engagement will provide information for the social LCA and the development of the collaborative, safe and inclusive bioremediation guidance document (T2.3).

4 CONCLUSIONS

This deliverable summarizes the planning and timeframe for data collection and monitoring of the SYMBIOREM technological solutions installed at the field sites. It describes the sites' characteristics and a preliminary definition of the comparability criteria between the sites. The sites studied in SYMBIOREM are very diverse in terms of climatic, environmental, and socio-economic characteristics but also in the

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source, concentration, and type of pollution. However, some of sites apply and develop similar bioremediation solutions, in total the project develops eight remediation solutions: phytoremediation; bioremediation with freshwater mussels attached to a floating wetland; anaerobic bioreactor with natural attenuation; bioaugmentation; biostimulation; biopiling; cascade bioreactor; combined use of the floating island with an extended surface with immobilized microorganisms. The data collected for each solution and each site is listed in the excel spreadsheet attached, as annex, to this deliverable. The spreadsheet will be updated throughout the experiments as data are collected and stored in the database. Task 2.1 (M1-M42) of which D2.1 is part, will be further developed to better integrate collected data at the demo sites with other WPs, such as WP5 and WP6, to analyse the risk and benefits of the solutions. In addition, D2.1 will be linked to D2.2 to develop a comprehensive approach for the involvement of citizens and stakeholders in the activities conducted at the demos sites and to ensure the human health and safety of the communities involved (MS3).

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6. ANNEX 1

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symbiorem

	A	B	C
1	**Table headings as in the next sheets**	**Explantion of the meaning of each heading**	**Reason why we need this data**
2	Site name	Name of the site where the experiments will be conducted	obvious
3	Location of the experiments (coordinates)	Coordinates or address of the site where the experiments will be conducted	as a reference for further checks
4	Type of pollution (list contaminants)	List of contaminants that occurr at the site or in the water/landfill leachate for which the remediation is conducted In the project	to "compare" remediation methods with same types of contaminants
5	Type of remediation	What type of remediation is conducted, bioremdiation with m.o., phytoremediation, combined remediation, water treatment with CW, etc.	To categorize the remediation strategies and use this data for WP5
6	Task in the DoA	What task in the doA does the study belong to? What WP?	for organizational purposes
7	TRL	Technology readiness leavel	as a refence
8	Type of experiments conducted	List the type of experiments conducted at the site and/or in the lab. This can be explained in brief and a complete description of the expiremental design can be attached in appendix	to record information and potentially "compare" similar experimental procedures
9	Type of experimental control	Describe the experimental control, what does it consists of? Is It a nearby uncontaminated site, or is it a blank (no treatment)?	as a reference for further checks
10	List of parameters to be analyzed	List all the parameters that you intend to analyse in the experiment, including environmental parameters (air humidity, soil moisture, etc.). Include baseline parameters as well, if any.	to record data and potentially "compare" similar experimental procedures
11	Types of samples to be collected for analysis	List the type of samples (soil, soil solution, runoff water, biomass, etc.) that you will collect for the experiement	for data collection
12	Location of samples collection (coordinates)	Indicate where the samples are collected at the site, you can use a map or coordinates. The map can be attached as appendix. Call the location on the map with different codes (#1.1) which are then report in this table as follows. For example, soil samples are collected from #1.2 #2.3 and #2.6 as indicated in the map; biomass is collected from each plant on the site, and runoff water is collected at location #2.2 and #6.5 as indicated on the map.	as a reference for further checks
13	Methods of sample collection	List all the methods you use to collect samples (e.g., soil sample will be collected with a manually operated auger at 25 cm depth, the soil is then collected in a ziplog bag and stored at 4C before analaysis)	to record information and potentially "compare" similar experimental procedures
14	Methods of sample analysis	List the methods of sample analysis for each type of sample collected (e.g., heavy metals in soil are analysed by ICP-MS)	for data collection
15	Frequency of samples collection and analysis	Indicate how often you will collect samples within the duration of the study (e.g., in the Bioelectrification phytoremediation study, soil samples will be collected two times, before the start of the experiment and at the end of the experiment)	for data collection and organizational purposes
16	Estimation of one-time-use lab supplies used for the study	Indicate the amount (kg) of one-time use lab supplies (such as pipette tips, plas	to make our study more concious of waste and use the data for the circular tool and the businnes models
17	Material Inputs	Indicate the type of materials utilized for the experiments (e.g., coconut fiber, cardboard, metal, plastic, etc.)	to be used in the circularity assessment and in the LCA/business models
18	Energy utilized	indicate the type and amount (e.g., kWh) of energy used to conduct the experiment	to be used in the circularity assessment and in the LCA/business models
19	Community data - activities	Indicate the type of activities the citizens will be involved with (e.g., contribution to experimental design and planning; provision of information about local issues and challenges; data collection and analysis; etc.) A way to characterize the contribution is by using categories, such as : 1. attend (walk/open day), 2. volunteer (we lead enviro work such as planting or water samples), 3. lead (they lead an event).	to be used in the circularity assessment and in the LCA/business models
20	Community data - time spent	Indicate the amount (hr or days) of time the citizens will be engaged for in the experiment in each of the activity listed under "community data - activities". It is often difficult to record specific hours that community members attend events at for each person and one can record it as number of events they attended and the type of event, this is then easy to convert back to hours.	to be used in the circularity assessment and in the LCA/business models

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Lake Neusiedl																		
4	Mesocosms study (Neusiedlersee)	it depends on permission	relevant nutrients like different forms of nitrogen and phosphoros together with Chlorine as this seems to be relevant in the more saline environment of the lake - depending on the initial pre-sampling and analysis by CNR in spring 2023 potentially further ones	remediation by floating wetlands enhanced with freshwater mussels and associated microbial, plant uptake as well as other physical and biochemical processes	T 4.5	3 to 4	semi-natural experiments in mesocosms. 4 treatments, 4 replicates in 16 mesocosms: t.1 4 mesocosms blank (without mussels without sediment); t.2 4 mesocosms with suspended mussels (without sediment); t.3 4 mesocosms with suspended mussels (with sediment); t.4 4 mesocosms with mussels in the sediments. This makes 16 mesocosms, right?	4 mesocosm blank (without mussels or sediment)	N-NH4; N-NO3; Ntot; P-PO4; Ptot; Chl; pH; dissolved oxygen; organic matter concentration, potentially additional ones after pre-sampling by CNR in spring 2023	water; sediment; mussels?	Neusiedlersee	pipette; filtration; van Dorn bottle; sediment core sampler; hand collection of freshwater mussels	standard analytical methods for nutrients in water and sediments; fluorimetric or spectrofotometric analysis of Chl; and O.M.? What about D.O.?	sampling the sediments at the beginning and at the end of the test period; sampling water every week; for about 6 months in total?	glassware/plastic containers; Ziploc bags; pipette tips; gloves; chemicals; etc. TBD	glassware; plastic pipette tip; plastic bottles; gloves; floating wetland, plants; anchoring system; material for the mesocosm, pre-grown mussels	Solar energy; fuel for the boat to reach the floating the island	Attend events; volunteer in data sampling and analysis	3 events and 4-5 volunteering activities
5	Laboratory and artificial pond (Verbania)	45.923816, 8.548152	relevant nutrients like different forms of nitrogen and phosphoros together with Chlorine as this seems to be relevant in the more saline environment of the lake - depending on the initial pre-sampling and analysis by CNR in spring 2023 potentially further ones	remediation by freshwater mussels	T 4.5	3 to 4	Lab experiments (short and long term) to test mussels' absorption and excretion rates under increasing nutrient concentrations and variable temperature conditions (with and without sediments). Sediments will be taken from the lake Neusiedl for lab tests.	blank (without mussels)	N-NH4; N-NO3; Ntot; P-PO4; Ptot; Chl; pH; dissolved oxygen, potentially additional ones after pre-sampling by CNR in spring 2023	water; sediment; mussels?	laboratory	pipette; filtration; hand collection of freshwater mussels	standard analytical methods for nutrients in water and sediments; fluorimetric or spectrofotometric analysis of Chl	short term experiments (24 hours): collection at the beginning and at the end of the experiment; long term experiments (36-72 hours): collection every 24 hours.	glassware/plastic containers; Ziploc bags; pipette tips; gloves; chemicals; etc. TBD	glass ware; plastic pipette tips; gloves	electricity for the lab experiments	none	none
6																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Landfill leachate treatment in mini-systems (Asutria)																		
4	Landfill leachate experiments (Austria)	48.1946° N, 16.2763° E	Relevant nutrients like different forms of nitrogen and phosphoros together with sodium chloride as this seems to be in high concentrations based on results of leachate samples analyses. Heavy metals (selected based on leachate composition); COD or BOD, total suspended solids,	landfill leachate treatment by VertECO treatment wetlands systems in lab-scale experimental setup using different substrates and vegetation. Remediation is a combined result of plants, substrate and micro-organisms.	T 4.6	3 to 5	1) Lab-scale prototypes of VertECO set in different configurations (substrate/plants) to test landfill leachate treatment under different influent concentration. 2) Sorption experiments to identify the best filter materials.	blank (same substrate configuration, but without plants)	N-NH4; N-NO3; (Ntot); PO4-P or Ptot; Chl; pH; electrical conductivity, temperature, COD or BOD, TSS, and selected heavy metals after pre-sampling the influent for 2023.	water	same as cell B4	manual collection	Standard analytical methods for pollutants in wastewater (spectrofotometric methods); ICP-MS for heavy metals, turbidymeter for trubidity, EC-meter, pH-meter,	sampling the sediments at the beginning and at the end of the test period; sampling water every week; for about 2 months in total. 10 parameters, sampled 6 times. Influent and Effluents samples analysed.	Glassware/plastic containers; Ziploc bags; pipette tips; gloves; chemicals; etc. TBD	Experimental prototypes, plants; substrates, peristaltic pumps, influent wastewater IBC tanks, glassware; plastic pipette tip; plastic bottles; gloves;	Electricity for the lab experiments (pumping wastewater continously in the system, light for plants if it is in indoor environment).	none	none
5																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Lower Austria	field or greenhouse, TBD	PAHs and heavy metal	Phytoremediation combined with electroculture	T3.5, WP3	4 to 5	phytoremdiation, pot experiment conducted in the greenhouse or in an open space (field, garden)	no treatment, potted soil from the contaminated site without any treatment but under the same conditions as the treated pots	soil moisture (%)	soil (subsample of potted soil from each pot)	from each pot	manual soil collection from each pot	ICP-MS for heavy metals	2 times, before the experiment (baseline) and at harvest when the experiment is concluded	glassware/plastic containers; Ziploc bags; pipette tips; gloves; chemicals; etc. TBD	Plastic pots; material for electro culture; auger for soil sampling; pipette tips; Ziploc bags; gloves; tubes; glassware	mostly solar energy; electric energy for the greenhouse temperature and humidity control	Attend events; volunteer in data sampling and analysis	3 events and 4-5 volunteering activities
4									soil pH	plant biomass (whole plant from each pot)		manual plant biomass collection from each pot	GS-MS for PAHs						
5									Soil cation exchange capacity (meq./100 g)	plant roots (roots washed off the soil, one root system out of 3 replicates)		manual plant roots collection from each pot							
6									Soil organic matter (%)										
7									Soil bulk density (g/m3)										
8									Concentration of contaminants (PAHs) (mg/kg)										
9									Concentration of heavy metals (Ni, Cd, Zn, etc.) (mg/kg)										
10									Plant biomass production (g)										
11									Plant root production (g)										
12									Soil micorbial activity?										
13																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Baltic Sea	lab scale (no coordinates)	PAH	anaerobic bioreactors with natural attenuation, bioaugmentation, biostimulation	T 4.1	3 to 5	Bioreactor experiment in batch	without addition of trace elements & specific microorganisms	PAH compounds, pH, microbial community, sulfate, nitrate	bioreactor samples/batch test samples	lab at KTH	manual	PAH: HPLC/GC-MS, pH= pHmeter, microbial community: DNA extraction, PCR, sequencing, ions: IC	bioreactor: every three days/weekly/monthly	PAH: extraction: acetone 30 mL/sample, IC: .. ml .. /per sample, ICP:.... ml/sample,	what material do you use for the batch esperiment? Do you build the bioreactor or will you/have you purchased?	batch bioreactors: no electricity at room temperature	none	none
4			phosphorus /metals&metalloids	anaerobic bioreactors/ bioelaching	T4.2	3 to 5	Bioreactor experiment in batch	without organic carbon / without specific microorganism addition for bioleaching, just pH change)	pH, phosphate, other anions&cations, metals/metalloids	bioreactor/batch test samples	lab at KTH	manual	phosphorus: spectrophotometer, IC metals: ICP pH= pHmeter, microbial community: DNA extraction, PCR, sequencing, ions: IC	bioreactors: daily/every three days/weekly, P crystallization:, Metal&Metalloid recovery	glassware/plastic containers; Ziploc bags; pipette tips; gloves; chemicals; etc. TBD		bioleaching: magnetic stirrers - 8.5 W *3 stirrers, 30 days operation in total ; P recovery: will be added, M recovery; will be added	none	none
5			PAH/phosphorus/metal&metalloids	cascade bioreactor (combination of Task 4.1. and Task 4.2)	T4.3	3 to 5	Bioreactor experiment continous	control ?	PAH compounds, pH, microbial community, sulfate, nitrate other anions & cations, metals/metalloids	bioreactor samples	lab at KTH	manual	same methods as Task 4.1. and Task 4.2.	daily/weekly		it will be based on the results of Task 4.1 and 4.2	cascade bioreactor (theroretical design, not optimized yet)	none	none
6																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Wroclaw-Osobowice	51°09'53.1"N 16°59'15.8"E	heavy metals: Zn, Cu, Cd, Pb, Cr	phytoremediation	T3.4	3 to 5	laboratory and field	soil without geocomposites	To be determined	soil and plants	51°09'54.2"N 16°59'14.4"E	manual collection of soil cores, plants biomass	To be determined	2/year for how long in total? Do you sample at the beggining and ned of the experiment?	glassware/plastic containers; Ziploc bags; pipette tips; gloves; chemicals; etc. TBD	Plastic pots; material for electro culture; auger for soil sampling; pipette tips; Ziploc bags; gloves; tubes; glassware	TBD	Attend events; volunteer in data sampling and analysis	3 events and 4-5 volunteering activities
4		https://goo.gl/maps/kDfg6ByEDk6tZjW5A							Heavy metals in soil (mg/kg)										
5									Plant biomass										
6									Soil characteristics										
7																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Park pond in Stanisław Tołpa Park, Wrocław	51º7′11.46″N, 17º3′16.87″E https://goo.gl/maps/TZYRLFribJyG1Nz1A	Nitrogen, Phosphorus, Organic matter, chlorophyll a	Combined remediation --> phytopremediation + bioremediation (the use of floating islands with extended surface with immobilised microorganisms)	T4.4	3 to 5	First year of the project: monitoring of water quality in situ.		Total Nitrogen, Nitrates, Nitrites, Ammonium Nitrogen, Organic Nitrogen; Total phospohorus, Phosphates; TOC; chlorophyll a; Conductivity; pH; Turbidity; temperature; BOD5; COD	Samples of water from city pond - collected from the edge of the pond approx. 2m from the edge, approx. 10cm under the water surface in 3 sampling points	51º7′11.46″N, 17º3′16.87″E	Manual collection	Nitrate nitrogen - Spectrophotometric method: PN-82C-04576/08 Ammonium nitrogen - Spectrophotometric method: PN-ISO 7150:2002 Nitrite nitrogen - Spectrophotometric method: PN-EN 26777:1999 Organic nitrogen - Computational method: PN-73/C-04576-14 Total nitrogen - Specific method: PN-EN 25663:2001 Total phosphorus - Spectrophotometric method: PN-EN ISO 6878/1:2006 Phosphates - Spectrophotometric method: ISO 6878/1:2006 pH - Potentiometric method: PN-EN ISO10523:2012 Electrolytic conductivity - Conductometric method: PN-EN 27888:1999 Turbidity - Nephelometric method: PN-EN ISO 7027-1:2016-09 TOC – Sievers InnovOx analyser (SCWO – Supercri tical Water Oxidation) Chlorophyll a – Spectrometric method: PN-ISO 10260 BOD - PN-EN 1899-2:2002 COD - PN-ISO 6060:2006	Once a month	1,5 kg	nitrile (gloves), fiberglass (filters), plastic	TBD	provision of inflormation about local issues and challenges; data collection and analysis; 1 and 2. Attend events; volunteer in data sampling and analysis	2h per event. 3 events and 4-5 volunteering activities
4							NOW (February 2023): pre-experiment. Experiment in the climate chamber with one selected plant species and floating wetlands available on the market to define the nutrients uptake by the plants and the required surface covered by the floating wetland. 3 tanks with 30L of medium - one is a control without floating wetland, 2nd has 50% of surface coverage, 3rd has 100% of surface coverage. 2 repetitions conducted at once.	Tank with contaminated water without floating wetland.	Total Nitrogen, Nitrates, Nitrites, Ammonium Nitrogen, Organic Nitrogen; Total phospohorus, Phosphates; TOC; chlorophyll a; Conductivity; pH; Turbidity	Samples of contaminated water from experimental tanks (without bottom sediments if they form).	Climate chamber in Institute of Environmental Enginnering UPWr	Manual collection	Same as above	Once a week	0,2 kg	coconut fiber, coconut chips, plastic, styrofoam, volcanic pumice	TBD	not applicable	not applicable
5																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		Community data	
2	Site name	Location of the experiments (coordinates)	Type of pollution (list contaminants)	Type of remediation	Task in the DoA	TRL	Type of experiments conducted	Type of experimental control	List of parameters to be analyzed	Types of samples to be collected for analysis	Location of samples collection (coordinates)	Methods of sample collection	Methods of sample analysis	Frequency of samples collection and analysis	Estimation of one-time-use lab supplies used for the study	Material inputs	Energy utilized	Activities	Time spent
3	Gallions Lake	51.498271, 0.086977	Road runoff pollutants (from a bus garage where they clean buses). Previous sampling data with a list of found pollutants is available (please see Appendices for Data Collection Plan D2.1 https://upvehueus.sharepoint.com/sites/symbiorem-o365/Documentos%20compartidos/Forms/AllItems.aspx?id=%2Fsites%2Fsymbiorem%2Do365%2FDocumentos%20compartidos%2FWP2%20Data%20collection%2C%20citizen%20science%20and%20safety&viewid=39f6c7b1%2Df22a%2D4347%2D9c9d%2D1335e65574d6)	Floating Wetland with freshwater mussels	T2.1; T2.2; T4.5	3 to 4	semi-natural experiments in mesocosms. 4 treatments, 4 replicates in 12 mesocosms: t.1 4 mesocosms blank (without mussels without sediment); t.2 4 mesocosms with suspended mussels (without sediment); t.3 4 mesocosms with suspended mussels (with sediment); t.4 4 mesocosms with mussels in the sediments. This makes 16 mesocosms, right?	Baseline data is being collected at five location around the lake prior to the floating wetlands going in. Then data will be collected after the wetlands have matured and prior to the mussels going in. This will allow us to see the impact of each solution.	"Orthophosphate (as P) Dissolved Orthophosphate (as P) Ammoniacal Nitrogen as N Nitrate (as N) Suspended Solids Dissolved Oxygen Electrical Conductivity Cadmium (dissolved) Copper (dissolved) Zinc (dissolved) PAH - Speciated (EPA 16) INC Total - (see appendix for full technical spec) - Benzo(a)pyrene and Pyrene only BTEX Biochemical Oxygen Demand (BOD) - 5 day Nitrate (as N03) Orthophosphate (as PO_4) Silicon Calcium (dissolved) Alkalinity (as $CaCO_3$) Total Organic Carbon (TOC) Nitrogen - Total (Kjeldahl) "	Water, sediment, musseles.	Location 1) 51.497611, 0.085510 Location 2) 51.497523, 0.086647 Location 3) 51.498172, 0.087573 Location 4) 51.498388, 0.086659 Location 5) 51.498267, 0.085186	Water is taken from the lake using a bucket. Glass bottles 300ml (x3) in size and 40 ml (x2) in size are filled to the top from the water in the bucket at each location. The samples are kept in a cool box with ice and taken to I2 Analytical for analysis. Additionally samples are taken seperately and either driven home/tested in the field depending on the location of future community volunteers.	The seperate analysis from the lab is carried out using Hanna Checkers for Phosphate, Nitrate and Ammonia. I2 Analytical method for analysis has been provided in Appendices. In previous reports from samples taken in the last 4 weeks, the methods for analysis have been provided.	TBC -This is still to be decided dependent on the methos decided for the project. However we have been sampling for 6 weeks prior to any wetland installation. Conversations have been taking place with others in Symbiorem. Needs uniformed monitoring program.	To be determined at a later stage			Attend - community open days, Lead - volunteers will carry out their own sampling and visual monitoring of mussels, Volunteer - volunteers will be able to attend water sampling training and training for monitoring the wetlands and mussels.	Currently dependent on how often sampling is required.
4								Still in coversation with Nicoletta	Still in coversation with Nicoletta	Still in coversation with Nicoletta	Between location 1 and 2 - still unknown	Still in coversation with Nicoletta	Still in coversation with Nicoletta						
5									N-NH_4; N-NO_3; Ntot; P-PO_4; Ptot; Chl; pH; dissolved oxygen; organic matter concentration									community using visual checks and Hanna Checkers.	3 events and 4-5 volunteering activities
6																			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1																		**Community data**	
2	**Site name**	**Location of the experiments (coordinates)**	**Type of pollution (list contaminants)**	**Type of remediation**	**Task in the DoA**	**TRL**	**Type of experiments conducted**	**Type of experimental control**	**List of parameters to be analyzed**	**Types of samples to be collected for analysis**	**Location of samples collection (coordinates)**	**Methods of sample collection**	**Methods of sample analysis**	**Frequency of samples collection and analysis**	**Estimation of one-time-use lab supplies used for the study**	**Material inputs**	**Energy utilized**	**Activities**	**Time spent**
3	Barakaldo	To be provided	PAHs	Bioremediation/Phytoremediation	3.1	3 to 5	Barakaldo soil bioremediation under biopile and phytoremediation. Exploratory sampling and characterization, at various points of each location, to determine the type and degree of contamination. In this project we are looking for a type of contamination that allows us to apply phytoremediation and bioremediation techniques.	Do not apply, contaminated soil without treatment	PAHs content, metals content, total microorganism,moisture, pH , electric conductivity, soil texture, nutrients.	Soil samples and plant samples	UPV/EHU	Extraction by excavator and screening. Manual sample collection	Microorganism: Petri dish culture Moisture: Oven dry at 105 ºC pH and conductivity: probe Hydrocarbons: gas chromatography with flame ionization detector	Before the experiments and at plant harvest, end of the experiment	Difficult to estimate but considering gloves, work overalls (reused), masks, zip lock plastic bags, it will be around 3 to 15 kg	_	Not defined	Attend events; volunteer in data sampling and analysis	3 events and 4-5 volunteering activities
4	Barakaldo	To be provided	PAHs	Bioremediation/Phytoremediation	3.2	3 to 5	Barakaldo soil nanobioremediation under biopile	Contaminated soil without amendments and treated in the same environmental conditions	PAHs content, moisture, pH, oxigen	Soil samples	UPV/EHU	The biopile is divided into different areas. 10-12 samples of diferent area taken of the different areas, of about 300 to 500 g in a random approach. They are combined and thoroughly mixed to create one representative sample. This procedure is repeated two more times.	Hydrocarbons: gas chromatography with flame ionization detector	It depends on the evolution but at least 1 per month, during the experiments	Difficult to estimate but considering gloves, work overalls (reused), masks, zip lock plastic bags, it will be around 3 to 15 kg	Recovered nanoparticles, nutrients, water, compost	Not defined	Attend events; volunteer in data sampling and analysis	3 events and 4-5 volunteering activities
5																			

Site name	Location of the experiments (coordinates)	Type of pollution (list contaminants)	Type of remediation	Task in the DoA	TRL	Type of experiments conducted	Type of experimental control	List of parameters to be analyzed	Types of samples to be collected for analysis	Location of samples collection (coordinates)	Methods of sample collection	Methods of sample analysis	Frequency of samples collection and analysis	Estimation of one-time-use lab supplies used for the study	Material inputs	Energy utilized	Activities	Time spent
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Azkoitia Brownfield - Basque country - Spain	Experiments at lab scale in GAIKER (Zamudio-Bizkaia- Basque country Spain)GAIKER GPS coordenates: 43º 17' 32,89'' N, 2º 51' 40,91'' O	Total hydrocarbons C10-C40 1000 mg/kg	Biostimulation	T3.2		Optimization of bioestimulation conditions at lab scale (GAIKER). .	Contaminated soil without amendments and reated in the same environmental conditions	Total microorganism,moisture, pH , electric conductivity, Hydrocarbons content	Soil samples	GAIKER GPS coordenates: 43º 17' 32,89'' N, 2º 51' 40,91'' O	Well-mixed soil samples will be collected manually, stored in a clean vial or zip-bag and kept at room temeperature till analysis. Microbiological analysis will be inmediately performed	Microorganism. Petri dish culture Moisture.- Oven dry at 105 ºC pH and condustivity: probe Hydrocarbons: gas chromatography with flame ionization detector	It depends on the evolution but at least 1 per month, during the experiments	Very difficult to estimate at this stage of project implementation, but LOW	Nutrients : compost, Urea, amonium nitrate,….	No relevant	Not applicable	Not applicable
Azkoitia Brownfield - Basque country - Spain	Experiments at lab scale in GAIKER (Zamudio-Bizkaia- Basque country Spain)	Toluene	Gene bioaugmentation	T3.3		CRISPR/CAS9 experiments to generate a metionine-auxotrophic bacteria (Pseudomonas aeruginosa) . Gene bioaugmentation by bacterial transformation with toluene degradation plasmids.	Wild type Pseudomonas aeruginosa (genetically NOT modified).	Growth in the absence of metionine. Growth in a medium containing toluene as the only carbon source. Toluene degradation.	Do not apply. *In vitro* approach.	Do not apply. *In vitro* approach.	Do not apply. *In vitro* approach.	Do not apply. *In vitro* approach.	Do not apply. *In vitro* approach.	Very difficult to estimate at this stage of project implementation; let's say around 5 to 10 kg.	Cas9 protein, several single-guide RNAs (sgRNAs), several HDR template DNA molecules, eGFP, toluene	Same as in a standard cell biology laboratory, difficult to stimate at this stage	Not applicable	Not applicable
Azkoitia Brownfield - Basque country - Spain	Experiments at lab scale in GAIKER (Zamudio-Bizkaia- Basque country Spain)GAIKER GPS coordenates: 43º 17' 32,89'' N, 2º 51' 40,91'' O	Total hydrocarbons C10-C40 1000 mg/kg	Bioaugmentation	T3.2		Optimization of bioaugmentation conditions at lab scale (GAIKER). .	Contaminated soil treated in the same environmental conditions	Total microorganism,moisture, pH , electric conductivity, Hydrocarbons content	Soil samples	GAIKER GPS coordenates: 43º 17' 32,89'' N, 2º 51' 40,91'' O	Well-mixed soil samples will be collected manually, stored in a clean vial or zip-bag and kept at room temeperature till analysis. Microbiological analysis will be inmediately performed	Microorganism. Petri dish culture Moisture.- Oven dry at 105 ºC pH and condustivity: probe Hydrocarbons: gas chromatography with flame ionization detector	It depends on the evolution but at least 1 per month, during the experiments	Very difficult to estimate at this stage of project implementation, but LOW	No relevant	No relevant	Not applicable	Not applicable
Azkoitia Brownfield - Basque country - Spain	Azkoitia (Gipuzkoa - Basque country - Spain) coordinates 43.176244, -2.304700	Total hydrocarbons C10-C40 1000 mg/kg	Bioremediation Biopiling	T3.2	3 to 5	Azkoitia soil bioremediation under biopile	Contaminated soil without amendments and treated in the same environmental conditions	Total microorganism,moisture, pH , electric conductivity, Total hydrocarbons	Soil samples	Azkoitia (Gipuzkoa - Basque country - Spain) coordinates 43.176244, -2.304700	The biopile is fictitiously broken into smaller subareas. 10-12 subsamples of about 300 to 500 g are taken in a random approach, at different depths. They are combined and thoroughly mixed to create one representative sample. This procedure is repeated two more times.	Microorganism. Petri dish culture Moisture.- Oven dry at 105 ºC pH and condustivity: probe Hydrocarbons: gas chromatography with flame ionization detector	It depends on the evolution but at least 1 per month, during the experiments	Difficult to estimate but considering gloves, work overalls (reused), masks, zip lock plastic bags, it will be around 3 to 15 kg	Water, compost, nanoparticles, nutrients	Compression claw pressure-vacuum pump of about 6 kw. Time odf use: 3h per day during 3 to 9 months. Estimated power consumption 18-25 kWh/day	Attend events; volunteer in data sampling and analysis	3 events and 4-5 volunteering activities

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3	Experimental farm Fersno, CA	TBD	Se, B, salts	Phytoremediation	T3.6	3 to 5	Field trials with guyaule (Parhenium argentatum) plant	Uncontamined soil planted with guayule	Se, B and salts concentrations in soil, water and plants	Soil, irrigation water, and plant biomass, latex and rubber	from the field site	manual collection of soil and plant samples	ICP-MS for salts, B, and Se	at the beginning of the experiemnts prior to planting and at the end. Duration of the experiments 1-2 years	2-5 kg, pipette tips, gloves, Ziploc bags, paper towel, etc.	plant seeds, irrigation water, fertilizers	Mostly solar energy, 20 L of fuel for truck operation for sampling and transport of samples to the lab	none	none
4									Soil pH and conductivity				HPLC-MS for Se speciation						
5									Plant biomass production										
6									Latex and rubber production										
7																			