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End-of-Waste Technical Information

Development of Pollutant Limit Values for Recycled Aggregate Products

Prepared for

Environmental Protection Agency
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EXECUTIVE SUMMARY

Geosyntec is pleased to present this report which details the assumptions and methodology adopted in the derivation of the proposed End-of-Waste Pollutant Limit Values (PLVs) for Recycled Aggregate. The PLVs have been developed on behalf of the Environmental Protection Agency (EPA) Ireland to help fulfil aspects of the End-of-Waste regulations. The proposed PLVs are screening criteria, for use in determining whether a proposed Recycled Aggregate product passes the End-of-Waste requirement of not posing a risk of adverse harm to human health or the environment. Assessment of other End-of-Waste requirements, which must be passed for Recycled Aggregate to cease to be classified as waste, do not fall within the scope of this report. The PLV guidance applies only to granular recycled aggregate products, where the grain size of any aggregate is sand sized or greater. It is envisioned that the information presented in this technical report will be predominantly used for the screening of recycled natural aggregates, recycled stone aggregates, concrete aggregates and mixed construction and demolition aggregates.

The proposed PLVs are a set of screening criteria against which either laboratory measured leachate data (10:1 L/S Ratio) or total (solid) concentration data from recycled aggregate is to be compared. The adopted approach mirrors that currently applied for waste acceptance criteria (WAC) used in the waste industry. The proposed PLVs have been developed for a group of commonly assessed determinands, again similar to that specified for WAC and includes metals, inorganic parameters (e.g. chloride, sulphate) and selected organic parameters (dissolved organic carbon, phenol, Mineral Oil >C10-C40, Total BTEX, Total PAH, Total PCBs). As a minimum, an operator must analyse the proposed Recycled Aggregate product for all compounds for which there are PLVs. If all tested compounds are at concentrations below PLVs then the proposed Recycled Aggregate product is deemed to not pose a risk of adverse environmental impact. If any laboratory-determined compound concentration exceeds its PLV then, unless further bespoke assessment takes place, the Recycled Aggregate in question will be deemed to pose a potential risk of adverse environmental impact and, as such, it will be deemed to remain a waste and cannot be used as a product.

Calculation of PLVs

The methodology and calculations applied in deriving the proposed PLVs are consistent with the UK Environment Agency (2006) Remedial Targets Methodology (RTM), the Groundwater Regulations (S.I. No. 9 of 2010, as amended) and the European Union Joint Working Group (2014) End-of-Waste guidance.

The overarching aim was to derive a set of criteria and associated guidance that is relatively simple and easy for end-users to apply, and for competent authorities to regulate, and that is protective of environmental and human health receptors.

The PLVs will be applicable across the Republic of Ireland and its varied geological settings and, as a result, they should be viewed as generic criteria. In effect, a "one size fits all" approach must apply and the compromise to achieve this is an inherent level of inbuilt conservatism, and a number of assumptions have had to be made in their development. That said, a degree of pragmatism has also been applied through discussions with the EPA and from a review of available leachate and total concentration Recycled Aggregate test data supplied by industry and local authorities, to derive what are considered to represent a workable set of criteria.

Assumptions that underpin the PLVs include the following:

- *The Recycled Aggregate product should not be derived from contaminated material or be derived from a known contaminated source, unless the recovery operation or prior treatment is capable of reducing contaminants to acceptable levels.*
- *The Recycled Aggregate product is assumed to be used for the purpose of fill or capping, which may, or may not, be covered by hardstanding (e.g. concrete or tarmacadam).*
- *The PLVs are only applicable to situations where the Recycled Aggregate product is used within the unsaturated zone - i.e. above the groundwater table.*
- *The PLVs are not the same as WAC and are not to be used as an alternative to WAC for assessing and disposal of designated waste materials.*

The PLVs have been derived through the following steps:

- *Step 1: selection of appropriate determinands for the determination of PLVs (and to be consistent with WAC).*
- *Steps 2, 3 and 4: in line with the UK Environment Agency (2006) RTM guidance:*
  - *Step 2, the identification of appropriate water quality standards (WQS),*
  - *Step 3 was the incorporation of (level 2) dilution,*
  - *Step 4 was the derivation of porewater target values.*
- *Step 5 conversion of pore water concentrations to equivalent 10:1 leachate concentrations, following approaches outlined in EU JRC (2014). These define the leachate based PLV criteria.*
- *Step 5b: derivation of solid total concentration values for determinands (e.g. organic chemicals) defined as solid total concentration values in the WAC criteria.*
- *Steps 6 and 7: comparative assessments against existing comparable criteria, available laboratory limits of detection (Step 6) and against available national and industry data sets and data from a laboratory trial. These final steps allowed for a sense check to be made to help determine whether proposed PLVs will be pragmatic and workable.*

The proposed PLVs have been calculated to be protective of groundwater via consideration of potential leaching of determinands from a Recycled Aggregate in the unsaturated zone and dilution of the leachate with groundwater as it reaches the saturated zone.

For a given determinand, the amount of leaching from a Recycled Aggregate is linked to how much infiltration will percolate through the materials. Additionally, the amount of infiltration is dependent on whether the Recycled Aggregate will be exposed at the surface or be present as a foundation material below impervious cover (e.g. roads). In view of this, PLVs have been developed for two different scenarios:

- *Scenario A (e.g. PLV-A criteria) assumes that Recycled Aggregate is exposed (at surface) and present over a high permeability subsoil, which overlies a groundwater aquifer (either unconsolidated drift or bedrock).*
- *Scenario B (e.g. PLV-B criteria) assumes that Recycled Aggregate is either located below hard standing or is present above a low permeability subsoil (e.g. clay) or drift, which overlies a groundwater aquifer. Under Scenario B, due to the presence of hard standing or a low permeability subsoil, there is a reduced*

potential for leachate from the Recycled Aggregate to reach the groundwater aquifer compared to Scenario A (i.e. a lower vulnerability setting).

Given that the PLVs need to be generic to enable their use across Ireland, no attenuation processes such as retardation, precipitation out of solution, biodegradation, advection dispersion within groundwater etc. has been incorporated in their derivation. However, a degree of pragmatism has been incorporated through the inclusion of a conservative level of dilution within underlying groundwater. Without the inclusion of dilution developed screening criteria would default towards level 1 pore water screening (as adopted in other EU End-of-Waste criteria), which are considered to be overly conservative and likely unworkable.

For the assessment of a conservative level of dilution (of any leachate within underlying groundwater) it has been assumed for both Scenario A and B, that the Recycled Aggregate product is placed over a 100 m x 100 m area. This is deemed a sufficiently large area with which to assess potential risks from the anticipated footprints for the typical use of aggregate materials. If a larger area was assumed, then calculated dilution factors will be even smaller and derived PLVs would be impractically low for use. The 100m x 100m area is deemed sufficiently large enough for the assessment of potential risks stemming from typical use scenarios for the Recycled Aggregate, such as fill beneath roads or pavements, as temporary hard standing, or as fill under roads and railway lines. The anticipated footprint for these scenarios is considered unlikely to be larger than 100 m in the direction of groundwater flow. The 100m x 100m assumption is consistent with other End-of-Waste guidance (e.g. Hjelmar, et al 2016). Linear features such as road/railway lines where a Recycled Aggregate may be used are considered unlikely to be wider than 100m in the direction of groundwater flow and, therefore are not considered to be excluded by this size constraint. The use of the 100m area has been pitched large enough to enable a sufficient level of conservatism to be incorporated for the calculation of dilution but at the same time to be sufficient to enable pragmatic PLVs to be calculated that are usable in the majority of situations where Recycled Aggregate is used.

As a 100 m x 100 m area has been assumed in calculations to generate PLVs and, as a result, these PLVs should not then be used to verify that a Recycled Aggregate does not pose adverse environmental impact if the aggregate is to be placed over an area wider than 100 m. If a smaller area was adopted in the calculation of the PLVs, then they would only be usable in a narrower set of scenarios.

Exclusion distances have been incorporated for situations where the use of PLVs do not apply for a groundwater abstraction point. It is recommended that a 25 m exclusion distance is placed in between the Recycled Aggregate and the abstraction point. For a natural surface water feature, spring, lake, turlough likely to flood and cavernous or karstified limestone features, it is recommended at 10 m exclusion distance is placed in between the Recycled Aggregate and such features. These exclusion distances:

(a) are consistent with distances applied in current guidance (e.g. European Union (Good Agricultural Practice for Protection of Waters) Regulations 2022, S.I. No. 113 of 2022; and EPA 2021, Code of Practice, Wastewater Treatment and Disposal Systems Serving Single Houses),

(b) will help limit the potential for accidental release of recycled aggregate/ concrete material or run-off into surface water; and

(c) allow for additional attenuation processes (e.g. biodegradation, retardation etc.) within the unsaturated and saturated zones to take effect, which are not currently included in the proposed PLVs. The proposed exclusion distances will provide for an additional factor of safety with respect to the protection of sensitive receptors.

Other Factors in the Determination of Potential Risks

The proposed PLVs and exclusion distances are protective of surface waters when dissolved phase contamination migrates via the groundwater pathway and will also aid in mitigating surface run-off from the aggregate. However, migration by surface water run-off can be rapid and much quicker than via a groundwater pathway. As such, there is an onus on the user of the aggregate to ensure that it is applied or used safely. Users should comply with relevant construction guidance to make sure it is applied appropriately to help prevent or minimise the generation of any surface run-off to start with and/or situations s where run-off generation cannot be avoided, and management measures are required to control it. "Prevention is better than cure" should apply.

The potential risks to human health should also be considered when using Recycled Aggregate. Total concentration Recycled Aggregate test data supplied by industry and local authorities has been screened against published human health generic assessment criteria (GAC) to determine whether potential risks to human health are posed by these materials. This screening identified that although low levels of petroleum hydrocarbon-based chemicals are reasonably common in Recycled Aggregates, proposed total concentration hydrocarbon s-PLV are set at low enough levels to minimise potential risks to Human Health. To limit the potential for an aggregate to fail a PLV due to mineral oil and or total PAH concentrations, it is recommended that any organic constituents (e.g. wood, asphalt, plastic etc) are removed where possible from the aggregate.

Isolated exceedances of 2014 Suitable 4 Use Levels (LQM/ CIEH) generic assessment criteria (GAC) protective of human health under Residential and Public Open Space (Residential) scenarios have been identified for some heavy metals. Additional PLVs derived from GAC are proposed for Recycled Aggregate for use in Residential and Public Open Space (Residential) settings to mitigate against potential risks linked to these land uses.

To protect against potential risks to human health and ecology is recommended that Recycled Aggregate is not used as growth medium in areas used for food production or livestock grazing, or as ground cover in areas where sensitive ecological species are present. This exclusion does not incorporate tracks within forestry and agricultural land, on which living organisms are likely to spend only limited time. Additionally, to determine whether a sensitive ecological species could be present, an assessment should be made by checking for statutory defined ecological sensitive sites, or by seeking the advice of a competent ecologist.

Further Important Considerations

Concrete aggregates have the potential to generate alkaline leachate for a short period of time after they are emplaced in the ground. Over time, reactions are expected to take place that reduce the potential for alkaline leachate to be generated and natural minerals have the potential to attenuate high pH levels in the subsurface. As such, no PLV is proposed for pH; however, simple steps are recommended whereby the Recycled Aggregate is stockpiled for a period of time to allow for pH reduction prior to use.

Although concrete predominantly comprises natural aggregates and cement (calcium, silicon and aluminium oxides), in some situations hardeners and plasticisers are added to the concrete to improve its properties. These hardeners and plasticisers comprise a mixture organic and inorganic determinands, which vary depending upon the brand or formulation applied. Limited research suggests that there is the potential for some determinands to leach out from impregnated concrete at low concentrations. In the case of epoxy resins, some of these can contain hazardous compounds. Given the range of potential determinands, which may, or may not, be present within concrete along with the difficulty in obtaining suitable commercial laboratory analytical suites, the derivation of specific PLVs is impractical at this stage. That being said, many of these potential leachable additives are likely to be indirectly identified through standard WAC suite laboratory analysis suites, such as mineral oil or Total

PAH (or even speciated TPH analysis where employed). Thus, elevated detections of mineral oil above solid s-PLVs would result in that batch of concrete being excluded. With regard to concrete with epoxy resin coatings, a precautionary approach is recommended, whereby concrete which is suspected to contain epoxy resins should be excluded from inputs in the production of Recycled Aggregates.

Cement present in concrete materials is produced through the superheating of natural rocks such as limestone. This process has the potential to convert trace levels of naturally chromium III, which is generally immobile and low toxicity, to chromium VI, which is more mobile and has a higher toxicity. Since 2003, European legislation has limited chromium VI concentrations in concrete to 2 mg/kg, in order to be protective of human health (e.g. construction workers exposed to cement), however, concrete cast prior to 2003 may have higher values than this. A review of industry supplied data has identified that total chromium and chromium VI concentrations in recycled concretes are unlikely to be present at levels that pose a potential risk to human health.

PLVs have been generated to be protective of the environment for total chromium (III plus VI). If total chromium concentrations in leachate for a recycled concrete aggregate are identified above the PLV-B, then either the material should be excluded, or consideration should be undertaken to determine whether the chromium is in the more mobile Cr VI form, or further risk-based assessment should be completed to determine whether the Recycled Aggregate is suitable for use. As a minimum, all Recycled Aggregate product should conform to the European Union REACH legislation requirement of having a Cr VI total concentration below 2 mg/kg.

A review of leach test data provided by industry and local authorities indicated leachable concentrations for antimony, molybdenum, selenium and sulphate can be derived from recycled rock materials. On rare occasions these concentrations may be greater than PLV-B making a natural aggregate unsuitable for use as a Recycled Aggregate product. Antimony may be present at elevated levels in hydrothermal and orogenic/metamorphic rocks, while molybdenum, selenium and sulphate are typically found in high concentrations in mudstones and shales. The friable nature of mudstone and shale rock types make them geotechnically unsuitable for use as a Recycled Aggregate product in some situations.

The final proposed PLVs are presented in Tables I and II, below:

Laboratory trials were undertaken in coordination with the EPA and Element Laboratory, Deeside, UK, on 6 recycled aggregate samples (4 concrete aggregates and 2 natural aggregates). These were collected by Geosyntec from stockpiles at three different producer facilities in Leinster that had been exposed to the elements for different periods of time post-crushing. The 6 aggregate samples were each split into 8 subsamples, 1 of which was analysed for total solid concentrations and the other 7 for leachate concentrations. The 7 leachate subsamples for each aggregate each underwent different laboratory preparations, designed to assess:

> *(i) whether laboratory preparation methods involving the crushing or grinding of recycled aggregate samples (or even on-site crushing of materials prior to shipping to the laboratory) increases leachable determinand concentrations, and*
>
> *(ii) whether the duration of holding/stockpiling between aggregate generation and subsequent testing has an impact on determinand leachate concentrations. Samples were analysed for determinands with PLVs and S-PLVs, other key constituents in aggregates and speciated hydrocarbons.*

Key findings from these trials were as follows:

- *Leachable concentrations for certain metals including chromium and for chloride, were greater in samples that had been crushed or ground, compared to those that had not. This increased leachability is likely to be linked to the increased surface area of the grains in these samples relative to sample mass.*
- *Based on the results of this study, leachable chromium concentrations in concrete aggregates samples crushed or ground by the laboratory pre-analysis have a greater potential to exceed PLVs than in samples tested as-received by the laboratory (with no crushing or grinding).*
- *Mineral Oil was measured above its S-PLV in 3 of the 4 concrete aggregate samples, however no leachable petroleum hydrocarbons were detected in any of the leachate subsamples. The detected Mineral Oil may indicate the presence of low-level contamination, or may be linked to additives included in production of the concrete.*
- *In controlled laboratory conditions, the leachability of chloride and certain metals including chromium, and leachate pH, in aggregate samples were observed to reduce over a period of six weeks with exposure to the elements (i.e. rain and the atmosphere).*

Table I - Proposed Leachate PLVs (as 10:1 L/S Ratio Leachate (mg/kg))

Compound	Target Levels, all values are in mg/kg	
	Proposed PLV-A	Proposed PLV-B
As	0.063	0.063
Ba	5.1	11
Cd	0.0074	0.0074
Cr Total	0.25	0.54
Cu	7.3	16
Hg	0.0057	0.0057
Mo	0.28	0.6
Ni	0.069	0.15
Pb	<0.05	0.078
Sb	0.17	0.37
Se	0.15	0.3
Zn	0.33	0.71
V	1	2.2
Chloride	440	950
Fluoride	4.2	9.1
Sulphate	1000	2200
Phenol	<0.1	<0.1
Dissolved Organic Carbon	180	400

Table II - Proposed Total (Solid) Concentration Targets (S-PLVs)

Compound	Proposed S-PLV
Total Organic Carbon	2.4 %*
Total BTEX	0.025 mg/kg
PCBs (7 Congeners)	0.035 mg/kg
Mineral Oil (C10-C40)	50 mg/kg**
Total PAHs (17 including coronene)	2 mg/kg
Chromium VI	2 mg/kg***
Arsenic	40 mg/kg****
Lead	310 mg/kg****

* Total Organic Carbon is a measure of all carbon with a sample including, but not limited to, plant and animal matter, wood, coal or ash and hydrocarbons.

** If the Mineral Oil (C10-C40) S-PLV is exceeded the aggregate is still considered to pass proposed PLV as long as the following conditions apply: A. it is not to be used for a residential or allotment end-use, B. the solid Mineral Oil (C10-C40) concentration is less than 200 mg/kg and, C. leachable concentrations of all speciated total petroleum hydrocarbon criteria working group (TPH-CWG) fractions within the Mineral Oil (C10-C40) range are below laboratory methods detection limits. Applicable 10:1 L/S Ratio laboratory method detection limits that should be met are:

- 0.05 mg/kg: TPH Aliphatic (>C10-C12), TPH Aromatic (>C10-C12)
- 0.1 mg/kg: TPH Aliphatic (>C12-C16), TPH Aliphatic (>C16-C21), TPH Aliphatic (>C21-C35), TPH Aliphatic (>C21-C44), TPH Aromatic (>C12-C16), TPH Aromatic (>C16-C21), TPH Aromatic (>C21-C35), TPH Aromatic (>C21-C44).

*** This is not calculated as a new PLV and applies to Recycled Concrete Aggregates only. Requirement of REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation (2006) for cement. The 2 mg/kg CrVI REACH criteria is protective of human health (construction workers) and is considered appropriate to apply to the handling of Recycled Concrete Aggregate Product for the same reasons. Refer to Section 5.3 for further discussion of chromium.

****Arsenic and lead S-PLVs only apply when the proposed end use of the Recycled Aggregate will be in a residential setting or public open space adjacent to a residential setting.

LIMITATION

Geosyntec Consultants Ltd (Geosyntec) has prepared this report for the sole use of the Environmental Protection Agency (Ireland) in accordance with the Agreement under which our services were performed. No other warranty, express or implied, is made as to the professional advice included in this report or any other services provided by us. This report may not be relied upon by any other party without the prior and express written agreement of Geosyntec, which will not be unreasonably withheld.

The conclusions and recommendations contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested. Information obtained from third parties has not been independently verified by Geosyntec, unless otherwise stated in the report.

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1 GENERAL INTRODUCTION

1.1 Introduction and Scope

Geosyntec Consultants, Ltd (Geosyntec) were commissioned by the Environment Protection Agency (Ireland) (EPA) to provide technical support for the development of proposed End-of-Waste Pollutant Limit Values (PLVs) for granular recycled aggregate products (Recycled Aggregate). This work has been undertaken in line with Geosyntec's proposal (Ref. WP044/05/GW/GW) and the contract for works signed by the EPA and Geosyntec on 12th May 2022.

The technical information provided in this report is in support of the European Union (Waste Directive) Regulations 2011-2020 (the Regulations). The overarching aim of the proposed PLVs presented in this document is that they can be used to help determine whether a Recycled Aggregate meets requirement 28(1)(a)(iv) of the Regulations:

> *28. (1) (a) Certain specified waste shall cease to be waste when it has undergone a recovery, including recycling, operation and complies with specific criteria to be developed in accordance with the following conditions:*
>
> *… (iv) the use of the substance or object will not lead to overall adverse environmental or human health impacts.*

This requirement is one of four requirements under 28 (1)(a) which a recycled aggregate waste needs to meet in order for it to cease being classified as a waste and become a Recycled Aggregate. The other three requirements as listed under 28 (1)(a) are:

> *(i) the substance or object is commonly used for specific purposes;*
>
> *(ii) a market or demand exists for such a substance or object;*
>
> *(iii) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products;*

The proposed PLVs presented in this document cannot be used to determine whether a Recycled Aggregate meets the requirement of regulations 28(1)(a)(i), (ii) or (iii).

The PLVs also provide no information on the geotechnical suitability of a given Recycled Aggregate product. Any Recycled Aggregate product should be proven to be suitable for re-use by a producer in line with appropriate industry and regulator standards.

This document does not represent stand-alone guidance in itself, but rather, provides technical information behind the development of PLVs that ultimately will form part of the development of National-level End-of-Waste Criteria for Recycled Aggregates by the EPA. If any contradictions are present between wording in this document and that in official EPA publications, the EPA publications take precedent and should be followed.

1.2 Objectives

The objectives of the project that are reported herein are:

- Derive proposed PLVs for Recycled Aggregate to help determine whether Regulation 28(1)(a)(iv) of the Regulations is met;
- Aid in defining the range of aggregates for which the PLVs can be used; and
- Define clear limitations for use of the PLVs and scenarios for which they are applicable.

As part of these objectives and to help ensure that practicable PLVs be developed, recycled aggregate chemical composition data supplied by industry to the EPA has been analysed and a summary of this data is also provided within this report.

1.3 Report Structure

This report is comprised of the following main sections:

- Section 2 – Summarises the Conceptual Site Model (CSM) used to define PLVs, the methodology and assumptions used to calculate PLVs.
- Section 3 – This section presents the proposed PLVs, recommended scenarios for which PLVs are applicable and outlines their intended method of use.
- Section 4 – Presents a discussion of other factors that should be considered when determining whether Regulation 28(1)(a)(iv) of the Regulations has been met (e.g., risks to human health, risks to surface water via run-off and risks to ecological receptors etc.). A summary of potential risks identified from recycled aggregate to human health and the environment, using data provided from industry, is also included.
- Section 5 – presents additional discussion on the leaching of pH from recycled concrete aggregate, contaminant background levels and possible leaching of additive chemicals from recycled concrete derived from sites where concrete containing additives have been used.

  A summary is also given of laboratory trials completed as part of this study, the report for which is presented in Appendix F.
- Section 6 – References

Appended to the report is supporting material and look-up tables to assist end-users in the correct application of the proposed PLVs.

1.4 Limitations to this Report

This report and its recommendations are based on information provided by the EPA and that available in published scientific literature and relevant guidance (which are referenced). Relevant third party published[1] information referenced in this report is assumed to be correct and Geosyntec accepts no liability for any incorrect third-party information that may be reproduced. Due to the nature of research, exact values may not be found for all calculation parameters and where appropriate assumptions have needed to be made, these are documented.

This technical report has been used to investigate and define proposed PLVs under the Regulations for Recycled Aggregate only, with the full list of recommended input wastes used to produce Recycled Aggregates is presented in Appendix B. These PLVs are only to be used for scenarios or materials detailed in this document. For other situations/scenarios, a site-specific detailed risk assessment applicable to the final use of the End-of-Waste product should be undertaken. EPA (2020a) should be consulted in the undertaking of any such detailed assessments.

At the request of the EPA, Recycled Aggregate derived from asphalt planings are not included within this assessment and calculated PLVs presented herein are not applicable for such materials. The EPA are currently developing separate guidance on the re-use of asphalt road planings.

2 CONCEPTUAL SITE MODEL

2.1 Introduction to Potential Recycled Materials

The Republic of Ireland published the Waste Action Plan for a Circular Economy in 2020 (Department of Communications, Climate Action and Environment, 2020) The plan promotes the reuse of resources as much as possible. In 2020 (EPA, 2022), 8.2 million tonnes of construction and demolition waste was collected in Ireland and of this, 84 % was classified as soils, stones and dredging spoil, 76% was concrete, brick, tile and gypsum and 5 % was mixed construction and demolition waste (EPA, 2021). The remaining constituents (<5 %) comprised metal, bituminous mixtures, wood, glass and plastic. Of the 8.2 million tonnes, 82 % was used for backfilling, 10 % was disposed to landfill, 8% was recycled and <1% was subject to energy recovery (EPA, 2021). The Waste Action Plan for a Circular Economy highlights the importance of maximising the recycling of the major waste components and minimising the amount of material subject to disposal. Reduced disposal:

- reduces the burden on landfills;
- leads to reductions in the amount of virgin aggregate material required for new developments; and

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[1] Published third party information such as scientific literature and technical guidance will have undergone peer review prior to publication. As such, Geosyntec review of this information primarily focuses on its relevance to the derivation of PLVs.

- reduces the greenhouse gas emissions from having to dispose of waste and excavate fresh virgin materials.

The materials classified by the EPA as being suitable for the use as a Recycled Aggregate and for which PLVs apply are presented in detail in **Appendix B** and include:

- gravel and crushed rock;
- sand and gravel materials from natural soil and stone;
- concrete;
- bricks, tiles and ceramics.

Where a waste input used to produce Recycled Aggregate does not meet the classifications in **Appendix B**, then the proposed PLVs do not apply, and the waste materials **cannot be used to produce Recycled Aggregate**. The EPA have deemed that the following should **not** be present in the waste input used to produce Recycled Aggregate:

- Asphalt road planings (as previously noted in Section 1.4).
- Epoxy resins: These are excluded as they contain hazardous compounds and the potential risks from these materials to the water environment is currently uncertain.
- Granulated tyre materials: These have the potential to leach a variety of contaminants including PAHs, aniline, bisphenols, benzothiazole, phthalates, metals, phenols, volatile organic compounds, cyanides and inorganics (ATSDR 2016, ECHA 2017a, Halsband et al 2020). In any case, these materials are unlikely to be suitable for use as a recycled aggregate due to their unsuitable geotechnical properties.
- Granular ash and slag materials (i.e. excluding ash that is bound within concrete, which is acceptable): Multiple metals and coke/ coal derivative compounds can be present in these materials often at high concentrations (EU JRC, 2014). In addition, ashes from municipal solid waste incinerators can leach phthalates, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins and furans (EU JRC, 2014).

While waste inputs may include some impurities/ physical contaminants (such as soil, metal, bituminous mixtures, wood, glass and plastic) the recovery process must be capable of reducing percentage content of the these to acceptable levels within the Recycled Aggregate output (product). The exclusion of any material from the current assessment does not exclude it from passing the end-of waste tests and becoming a viable product for other uses. In situations where a recycled material is classified (according to this document) as not being suitable for screening against PLVs, then discussion with the EPA is recommended, which may include the need for a bespoke risk assessment to be undertaken in accordance with the EPA (2020a) to determine whether said material could be used as a Recycled Aggregate product (either at a site-specific level or national level).

2.2 Background to Risk Assessment Approaches

It is expected that the end use of Recycled Aggregate products will be predominantly as engineering fill materials to fill-in voids, as a component of an earthworks, sub-base engineering fill or as a surface covering. There is the potential for chemicals and elements to leach out of Recycled Aggregate and to migrate down to an underlying aquifer, posing a potential risk to groundwater and/or surface run-off down-gradient to surface water receptors. To aid in the development of the proposed PLVs, generic risk assessment methodologies have been applied in order to determine possible leachable concentrations that would not be expected to pose a potential risk to groundwater underlying a site and to the wider water environment.

When undertaking a site-specific risk assessment (in accordance with the UK Environment Agency Remedial Targets Methodology (2006a)) to determine whether an unsaturated zone source potentially poses a risk to a groundwater receptor, multiple attenuation processes are typically modelled. These include:

- Unsaturated zone attenuation processes: leaching of chemicals from source material into pore water as a result of infiltration recharge from precipitation. Attenuation processes within the unsaturated zone include volatilisation of volatile compounds absorption of onto mineral and organic surfaces, along with possible abiotic degradation and biodegradation.
- “Level 2 Dilution” (as defined within EA (2006a) RTM): This infiltrated water containing dissolved phase chemicals is diluted through mixing within underlying groundwater. Such dilution is dependent on the infiltration rates and groundwater flow rates in the aquifer and results in a reduction in chemical concentrations in underlying groundwater compared to infiltrating leachate.
- Saturated zone attenuation processes within the receiving aquifer between the source and the point of compliance: dilution and advection-dispersion of chemicals, retardation through absorption onto mineral and organic surfaces and possible abiotic- and/or biodegradation.

It should be noted that processes such as irreversible chemical bonding and/or precipitation out of solution exhibited by many inorganic species interactions within soils are typically not included within off-the-shelf industry risk-assessment models, which assume linear and fully reversible equilibrium portioning. Such chemical interactions can provide additional site and species-specific attenuation mechanisms that are not readily accounted for. Many of the attenuation processes listed above are highly site-specific, hydrogeologically-specific and/or species-specific in nature. These processes are commonly assessed on a site-by-site basis to derive site-specific target criteria. However, it is hard to incorporate such site-specific processes when deriving generic assessment criteria (GAC), such as the PLVs, which are designed to be used irrespective of geographical location. An assessment of site-specific, hydrogeologically-specific and species-specific variability is summarised as follows:

- The geology of Ireland is highly variable in both a local and regional scale. Even at the site scale it can be highly variable. In some areas, thick layers of cohesive low permeability Glacial Till are present between shallow soils and an aquifer, while in other areas shallow soils sit directly on an unconfined aquifer. Further, an aquifer can consist of a sand and gravel unit, a highly permeable limestone aquifer, or a poorly productive aquifer characterised by groundwater flow restricted to localised fracture zones. Therefore, calculation of PLVs by considering a single highly characterised geological pathway that is representative of all situations is not considered meaningful or practicable.

- The potential for inorganic, metal and organic contaminants to leach from Recycled Aggregate and to adsorb onto minerals and organic surfaces in the subsoil and aquifers varies with a multitude of factors including but not limited to pH, reductive-oxidative (redox) conditions, the type of minerals present in the soil and the amount and sometimes the type of natural organic carbon present. As a result, adsorption partitioning coefficients (k_d) can vary over many orders of magnitude and the inclusion of this process would lead to high levels of uncertainty in derived values. In view of this, no sorption processes in the unsaturated soils or aquifer pathway have been included in the derivation of PLVs.
- Biodegradation of organic chemicals depends on the presence of the appropriate bacteria, nutrients and electron acceptors in the subsurface and is highly variable, even at the site scale, let alone regionally. Biodegradation rates for a given chemical may happen at varying rates, may stall unexpectedly or not occur at all, depending on groundwater conditions. Assuming that biodegradation is occurring at all sites is considered unreasonable and, therefore, has not been considered in the derivation of PLVs.
- The potential leaching of chemicals from a Recycled Aggregate represents a new potential release to the environment which is unlikely to be monitored or managed after placement. Fresh inputs to the environment should be limited as far as practicable such that significant environmental impacts do not result. This is particularly applicable to designated hazardous substances, which are prohibited from entering groundwater at measurable levels under current Groundwater Regulations. Therefore, it is not considered appropriate to include generic saturated zone attenuation processes in the derivation of PLVs as this, by default, assumes a plume to some extent will develop.

In view of the above, an approach has been developed to enable the derivation of proposed PLVs that accounts for the anticipated variability in the geological domains across the country, but also excludes processes and parameters that have a high degree of natural and site-specific variability (some of which are listed above).

The assumed point of compliance (where the concentration of a compound should equal or be below a regulatory defined water quality standard (WQS)) in the derivation of PLVs was set as follows:

- For hazardous substances, the compliance point for the assessment of risks was set as the base of the unsaturated zone (this is compliant with current EPA regulations). As such, the calculation of PLVs for hazardous substances did not incorporate any attenuation processes.
- For non-hazardous substances (and in accordance with EPA guidance), the compliance point for the assessment of risks was set as groundwater underling the Recycled Aggregate. Therefore, PLV calculations for non-hazardous compounds included attenuation due to dilution of leachate into underlying groundwater using the EA (2006a) RTM Level 2 dilution calculations (given that the any product should be located above the water table).

The calculation process for generating the PLVs is explained in detail in Section 2.3. The proposed method of calculation is more conservative than that used in the inert Waste Acceptance Criteria (WAC) published within the European Union Landfill Directive (2003/33/EC), but at the same time is less conservative than recent unrestricted use End-of-Waste Criteria (or PLVs) published elsewhere in the European Union, for example by the Nordic Council (Hjelmar, 2016)). The calculation for the inert WAC took into account dilution and saturated zone attenuation processes with a point of compliance 20 m down-gradient from a hypothetical landfill (Hjelmar et al, 2002). Such saturated zone attenuation was calculated using assumed parameters for a "typical" or "average aquifer" with reasonable hydraulic conductivity akin to a good yielding aquifer. Such conditions may not be applicable to many situations where sites are located over less productive low yielding aquifer strata/groundwater bodies that can still be used for potable water supply and importantly sustain baseflow to surface waters.

Additionally, the inert WAC were generated for identifying upper limits for contamination in waste materials in controlled landfill sites, often with leachate management systems and groundwater compliance monitoring (and mitigation where needed) in place. This post deposition management is an important distinction from the intended use of PLVs. In contrast, the proposed PLVs are used to define a threshold below which former waste materials are no longer classified as waste and can be used in situations where no further regulatory monitoring or assessment is needed post use. Therefore, a higher level of conservatism is considered to be warranted in the generation of the proposed PLVs, but at the same time the proposed approach is considered to be balanced, such that pragmatic PLVs are derived that allow the use of Recycled Aggregate in most site situations.

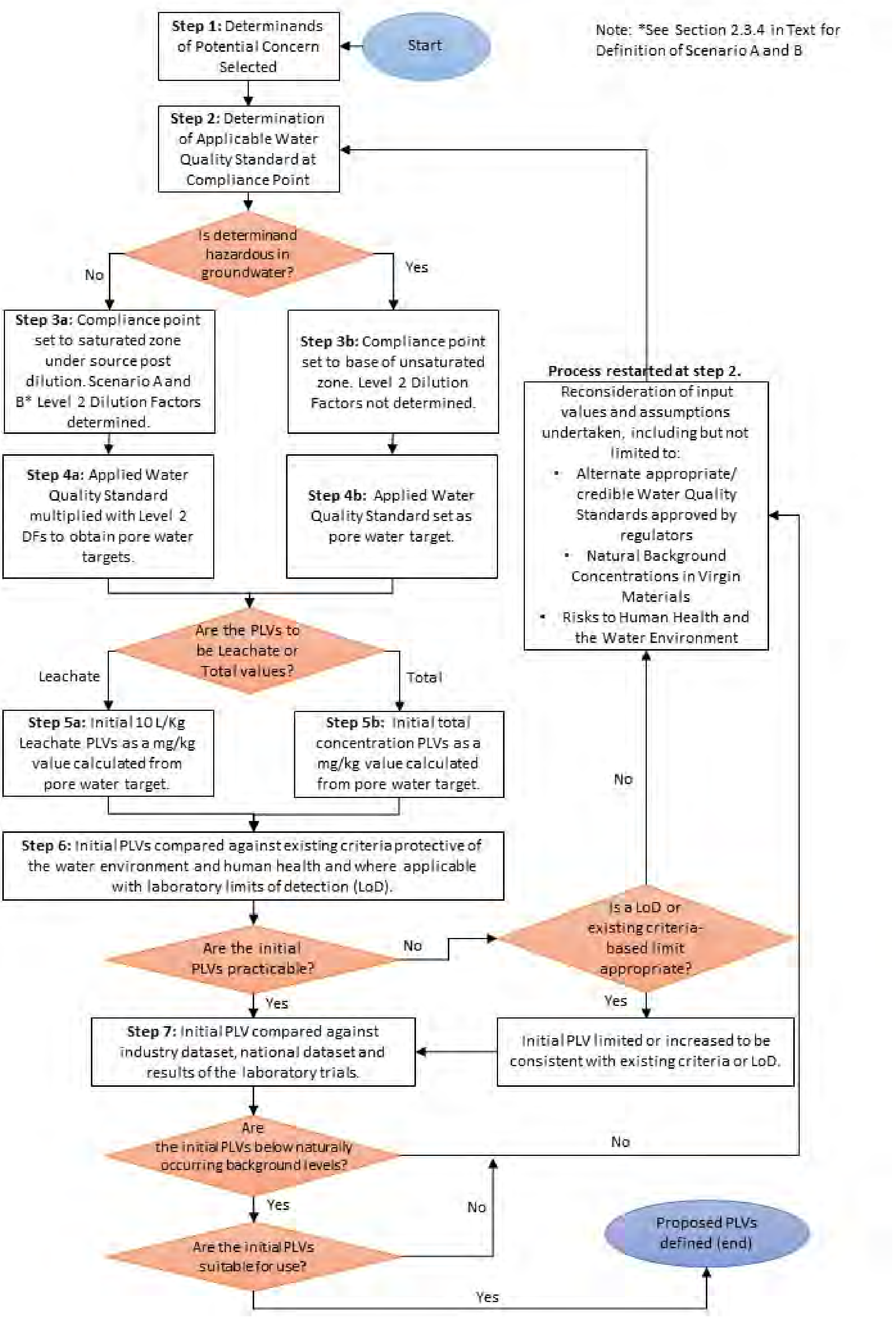
2.3 Methodology for Calculating Proposed PLVs

2.3.1 Overview

This section presents the step-by-step process for the calculation of the proposed PLVs, while Figure 2.1 below outlines the framework used to derive the proposed PLVs. Where appropriate, reference is made to scientific literature, guidance documents and/or supplementary information provided in appendices to this document.

Should PLVs need to be calculated for additional determinands (not currently included) or where PLVs require amending due to changes in regulations/WQS, then the procedures outlined within this document can be followed. However, it is recommended that such calculations are undertaken by an experienced environmental consultant competent in environmental and human health risk assessment.

Figure 2.1 Framework Summarising Approach Adopted for Calculating Proposed Pollutant Limit Values



2.3.2 *Step 1 – Selection of Determinands of Concern to be Modelled*

Determinands of potential concern that were considered for inclusion in the determination of PLVs were identified through review of existing studies into the reuse of waste materials (Enviros 2009, EU JRC 2014), through discussions with the EPA, and in line with the landfill WAC suite.

Inorganic determinands of potential concern identified for inclusion are summarised in Table 2.1 below.

Table 2.1 Summary of Inorganic Determinands of Potential Concern in Leachate from Recycled Aggregate Materials

Aggregate Type	EU JRC (2014)	Enviros (2009)	
	Determinands close to or above inert waste acceptance criteria for landfills	Determinands in excess of drinking water standards*	Determinands above inert waste acceptance criteria for landfills
Recycled Concrete Aggregate (RCA)	Ba, Cu, Cr, Mo, Ni, Pb, Sb, Se, Sn, V, SO_4	Al, Cr, Ca, F, K and pH	Cr, Sb and Total Dissolved Solids
Recycled Brick Aggregate (RBA)	As, Cr, Pb, Sb, Se, SO_4	Not included in study	Not included in study
Natural Aggregate (virgin materials)	As, Cd, Ni, Pb, Sb, Se, V	Not included in study	Not included in study
Limestone (virgin materials)	None Identified	None Identified	None Identified

* Enviros (2009) considered the following drinking water standards:

1. SI No. 278 of 2007, European Communities (Drinking Water) (No. 2) Regulations 2007
2. SI No. 81 of 1988, European Communities (Quality of Water Intended for Drinking Water) Regulations, 1988
3. World Health Organization, Guidelines for drinking-water quality, third edition, 2006

PLVs have been derived for the majority of determinands of potential concern listed in Table 2.1, and also, for mercury (Hg) and zinc (Zn). There is the potential for these heavy metals to be present within aggregates, particularly in situations where small levels of unknown ash or clinker may be present within a concrete (EU JRC 2014).

The following determinands that are listed in Table 2.1 but that have been excluded from the calculation of PLVs include:

- **Tin (Sn):** this element is generally only considered to pose a risk to human health and the water environment when in an organo-tin complex e.g. tributyl tin or triphenyl tin etc. Inorganic tin rather than organo-tin is detected in some leachates. Currently the Republic of Ireland has not defined a surface water environmental quality standard or Groundwater Threshold Value for tin. However, the World Health Organisation (WHO) concluded that inorganic tin has low toxicity and its potential presence in drinking water does not represent a hazard to human health (WHO, 2017).
- **pH:** although alkaline pH may leach from crushed concrete, this is considered to generally represent a short-lived and localised occurrence, rather than a sustained process capable of affecting off-site water chemistry. Alkaline pH is discussed in detail in Section 5.

- **Total Dissolved Solids (TDS):** although included within the original inert WAC guidance (2003/33/EC) as an alternative parameter to chloride and sulphate, it has not been included as a parameter requiring a PLV. This is because no relevant water quality standards are available for TDS. In view of this, PLVs have been generated for chloride and sulphate for which water quality standards are available and are deemed more defensible than a PLVs for TDS.
- **Calcium (Ca), Potassium (K) and Aluminium (Al):** along with iron, magnesium and sodium, these are common rock forming elements in alumino-silicate and carbonate minerals, present in natural materials and recycled concrete aggregates (Chen et al, 2013). The WHO (2017) drinking water guideline document does not provide human health-based thresholds for calcium and potassium. The current calcium WHO (2017) drinking water guideline of 100 to 300 mg/l, is based on taste thresholds rather than health-based limit. Potassium is an essential element. For aluminium WHO (2017) provide a health-based limit of 0.9 mg/l, which is considered unlikely to be commonly observed in natural groundwater conditions. The solubility of aluminium varies with pH. Around a pH of 7.2 (the median pH value of Irish groundwater (EPA (2017)) the solubility of aluminium would be expected to be less than 0.03 mg/l (Health Canada 2019), an order of magnitude less than the health-based limit. The solubility of aluminium increases in more acidic and alkaline groundwaters. At the limits of the recorded pH 5th to 95th percentile range in Irish groundwater (5.8 to 7.94 pH units), aluminium could be present at up to 0.3 to 3 mg/l, similar to the health-based limit. However, these concentrations are unlikely to be observed in drinking water with groundwater treatment systems typically promoting the flocculation and precipitation of aluminium to keep total concentrations less than 0.1 to 0.2 mg/l (WHO, 2017). Based on the above, these determinands are considered very unlikely to be risk drivers when assessing risks to human health or the water environment and, as such, are not considered further.

Ideally organic compounds should not be present within Recycled Aggregate (except potentially as a concrete additive (see Section 5.2)). However, it is recognised that low levels may be present as a result of:

- past industrial use of a building from which the aggregates have been sourced.
- contamination of the soil or material from which aggregates have been sourced. This could be due to a past land use (e.g. use of chemicals on agricultural land), past accidental leaks or spills on industrial or agricultural land or diffuse urban pollution (e.g. from road traffic).
- natural organic matter.

PLVs have been generated for a selection of common organic contaminants, including dissolved organic carbon (DOC), total organic carbon (TOC), benzene, toluene, total xylenes, phenol, total polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH) and polychlorinated biphenyls (PCBs). It is recognised that this is not an exhaustive list and other organic contaminants may be present within waste materials intended for recycling as aggregates. In such situations, then additional 'bespoke' characterisation and risk assessment is recommended in line with EPA (2020a).

To be consistent with current industry standard practice for characterising waste materials, DOC and phenol PLVs have been calculated as leachate concentrations, whilst TOC, total BTEX, total PAHs, Mineral Oil and total PCBs PLVs have been generated as total (solid) concentrations.

Total BTEX, Total PAHs, Mineral Oil and total PCBs are each organic chemical groups comprising multiple compounds. To generate PLVs for these groups, the following approach was adopted:

- PLVs were calculated for each individual analyte within the a given group that has an appropriate WQS.
- With regard to Mineral Oil, PLVs were calculated for aliphatic hydrocarbon bands between TPH C10 and C40, while the assessment of risks from aromatic hydrocarbon bandings was assumed to be covered through the assessment of risks posed by BTEX and PAHs that are the speciated risk driving chemicals present within the aromatic TPH fractions. This approach is in line with generally accepted risk assessment procedures outlined in CL:AIRE (2017).
- For PCBs, a single compound was considered - PCB28 (2,4,4′ - Trichlorobiphenyl), which is the lowest hydrocarbon chain length (and therefore likely most mobile) compound within the PCB 7 congeners analytical suite for which appropriate WQS and input values are promulgated.
- The final PLV adopted as a representative screening value for each of the above chemical groups was based on the lowest calculated PLV from the assessed individual compounds within that group.

For the assessment of PLVs, determinands have been classified as either hazardous or non-hazardous compounds as defined in EPA (2010). In the situation where a determinand is listed as "undetermined" or no designation is available within EPA (2010)[2], then the determinand has been assumed to be non-hazardous, unless available scientific literature suggests otherwise.

2.3.3 Step 2 – Calculation of Applied Water Quality Standard

A WQS represents the maximum acceptable concentration for a given determinand in groundwater or surface waters. For example, Groundwater Threshold Values (GTVs) in Ireland define the maximum acceptable concentrations in aquifers.

When applying WQS for the generation of PLVs, consideration of background concentrations that may already be present naturally within an aquifer needs to be made. As such an Applied WQS should be equal to the WQS of a determinand minus its background concentration (where available). For example, if determinand "X "has a WQS of 1 mg/l and the background concentration is 0.1 mg/l, then the Applied WQS of determinand "X" would be 0.9 mg/l.

The WQS, Applied WQS, available background concentrations and source references for the determinands considered for the generation of PLVs are provided in Appendix C.

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[2] Lead, selenium, chloride and dissolved organic carbon are not listed by EPA (2010) and sulphate is listed as "Undetermined".

The following order of preference was given to the selection of WQS for each compound:

- WQS protective of groundwater based on current Republic of Ireland regulations:
    1. Statutory Instrument No. 366 of 2016, European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 (WQS in this document are known as the Ireland GTVs)
    2. Statutory Instrument No. 122 of 2014, European Union (Drinking Water) (Amendment) Regulations 2014 (WQS in this document are known as Ireland Drinking Water Standards)
- WQS protective of surface water (freshwater) based on current Republic of Ireland regulations:
    3. Statutory Instrument 77 of 2019, European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019
    4. Statutory Instrument 386 of 2015, European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015
    5. Statutory Instrument 327 of 2012, European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2012
    6. Statutory Instrument 272 of 2009, European Union Environmental Objectives (Surface Waters) Regulations 2009
- Other WQS protective of groundwater/ drinking water (to be used where no Irish of EU criteria are available) include:
    7. 2017 World Health Organisation, Guidelines for Drinking Water Quality (4th Edition) (guidelines and health-based values)
    8. 2003 EPA Interim Guideline Values
    9. Other values defined in other EoW Guidance (Swedish, EU, Danish) and international screening values (e.g., US, UK)
- Other WQS protective of surface water (freshwater)
    10. European Chemical Agency point of no exposure concentration (non-statutory)
    11. Other values defined in other EoW Guidance (Swedish, EU, Danish) and international screening values (e.g., US, UK)

The following exceptions to the above hierarchy have been applied:

- For antimony (Sb) and selenium (Se), Ireland 2014 drinking water limits are not risk based criteria and have not been used. Instead, health based WHO (2017) criteria have been adopted.
- For dissolved organic carbon (DOC), no Irish risk based WQS protective of groundwater and surface water, or suitable international criterion has been identified. Given that no risk-based criteria are available for DOC, the adopted WQS standard has been set to the 95% percentile of Ireland background concentrations in groundwater (EPA 2017).

2.3.4 Step 3a, 3b – Determination of Applicable Level 2 Dilution Factors

As previously discussed in Section 2.2, UK Environment Agency (2006a) Remedial Targets Methodology (RTM) "Level 2 Dilution" assessment has been adopted as the main attenuation process considered for non-hazardous compounds when deriving PLVs. For hazardous substances, however, Level 2 Dilution is not taken into account when deriving PLVs. This approach is in line with Statutory Instrument No. 9 of 2010 (Groundwater Regulations) that requires the point of assessment for hazardous substance from new activities to be prior to entry into groundwater (e.g., at the base of the unsaturated zone).

The dilution of leachate into an underlying aquifer or saturated strata is highly dependent on the local/ site scale geology, hydrogeology and recharge rates for a given area or region. Calculating PLVs that are specific to a given local geology variant and recharge characteristic would lead to the generation of numerous area-specific PLVs that would be complicated and confusing to use at a national level. As such, a streamlined approach was adopted to derive a generic range of estimated dilution factors that cover the range of aquifer types in Ireland and ultimately would allow the adoption of a 'mid-range' or characteristic dilution factor for use in deriving the PLVs.

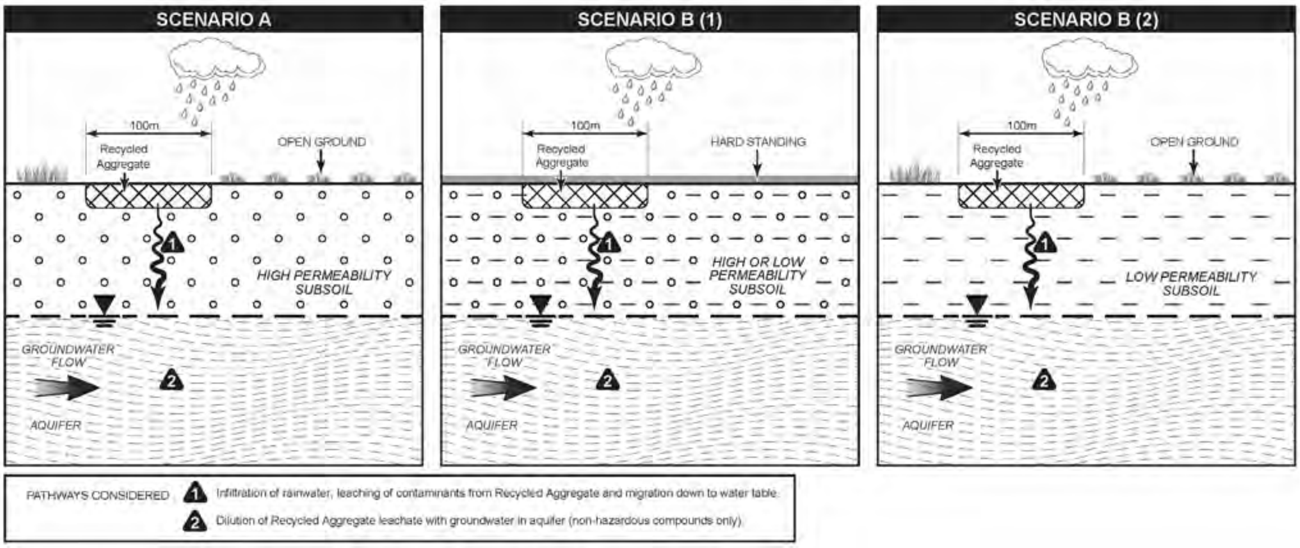
EA (2006) RTM Level 2 Dilution calculations require knowledge of (a) infiltration/recharge rates, (b) area of interest through which recharge will percolate, and (c) aquifer properties of the receiving aquifer, e.g. hydraulic conductivity and hydraulic gradient.

For the estimation of recharge rates, two scenarios were assessed, dependent upon whether the Recycled Aggregate will be exposed (as surface cover material) or be present below impervious cover (e.g. roads, concrete or bituminous surface layers etc.). Thus, the following scenarios were adopted:

- Scenario A (to derive PLV-A criteria): Assumes that the Recycled Aggregate is exposed and present over a high permeability subsoil, which overlies a groundwater aquifer (either unconsolidated drift or bedrock).
- Scenario B (to derive PLV-B criteria): Assumes that the Recycled Aggregate is either located below hard standing or is present above a low permeability subsoil (e.g. clay) or drift, which overlies a groundwater body or aquifer. Under Scenario B, due to the presence of hard standing or a low permeability subsoil, there is a reduced potential for leachate from the Recycled Aggregate to reach underlying groundwater compared to Scenario A. Thus, Scenario B represents a lower vulnerability setting than Scenario A.

These outline scenarios are shown schematically in Figure 2.2. below.

Figure 2.2 Schematic Conceptual Site Model of Different Scenarios Considered in the Generation of Pollutant Limit Values.



The assessed range of infiltration rates was derived from Geological Survey Ireland's (GSI), published groundwater recharge map (GSI, 2015) and values used to derive existing inert WAC (Hjelmar et al, 2002) guidance. A summary of the groundwater recharge rates considered and the applied recharge rates in calculations is given in Table 2.2 below.

Table 2.2 Summary of Recharge Rates Adopted for Dilution Calculations

Recharge Rate (mm/year)	Source & Assumption	Applied Recharge Rate (mm/year) for Dilution Calculations	
		Scenario A (100% recharge)	Scenario B (10% recharge)
500	GSI (2015) Groundwater Recharge Map. Approximate 90th percentile of recharge rate for Ireland as shown on the GSI map.	500	50
1,000	GSI (2015) Groundwater Recharge Map. Estimated recharge rate for a high rainfall karst aquifer in Ireland as shown on the GSI map.	1,000	100
300	WAC (Hjelmar et al, 2002) assumed for a hypothetical "average" sandy aquifer.	300	30

For the "source area" used in dilution calculations, a 100m x 100 m area for the Recycled Aggregate product was assumed for both Scenario A and Scenario B. This area is deemed sufficiently large for the assessment of potential risks stemming from typical use scenarios. These typical use scenarios could include but are not limited to use of the Recycled Aggregate as sub-base fill beneath roads or pavements, as temporary hard standing, as general fill or as fill under railway lines. The anticipated footprint for these scenarios is considered unlikely to be larger than 100 m in the direction of groundwater flow. Such an area is deemed applicable to roads (including motorways) and railway lines that will extend for kilometres given that shallow groundwater migration directions tend to follow topography and, as a result, are unlikely to be linear over extended distances. Thus, it is considered unlikely that a major transport hub would align perfectly with groundwater flow direction over an extended distance, and if it were (say for a regional bedrock aquifer, if it were unconfined), then this would represent a narrow point source relative to a regional scale of the aquifer. It should be noted that the 100m x 100m area is consistent with assumptions adopted by Hjelmar, et al (2016) for the calculation of Nordic End-of-Waste criteria for 100m bunds.

Level 2 dilution factor calculations for both Scenario A and B were completed for a total of eighteen aquifer types representing different recharge, geological and hydrogeological conditions typical for Ireland. Input parameters included groundwater recharge, aquifer thickness, aquifer hydraulic conductivity, aquifer hydraulic gradient for a range of aquifer types ranging from high permeability fractured aquifer, high permeability granular aquifer through to low permeability settings. The full range of input parameters, references and outputs are presented in Appendix A.

The use of 18 aquifer types enabled a sensitivity analysis to be undertaken before ultimately adopting a geometric mean dilution factor for Scenario A and Scenario B, as follows:

- Scenario A: Geometric mean of 1.46 derived from a range of dilution factors varying between 1.0 and 25.3.
- Scenario B: Geometric mean of 3.13 derived from a range of dilution factors varying between 1.03 and 241.3.

The final geometric mean Level 2 Dilution Factors calculated for both Scenarios are considered conservative low-end values that would be representative of most site settings across Ireland and would be appropriate for use in deriving PLVs. The geometric mean values for both Scenarios also compare favourably with (and are lower than) the dilution factors of 1.73 and 8.3 calculated using aquifer and recharge parameters adopted for inert WAC (Hjelmar et al, 2002).

2.3.5 *Step 4a, 4b – Calculation of Pore Water Targets*

The pore water target for non-hazardous compounds is equal to the Applied WQS multiplied by the Level 2 Dilution Factor (Step 4a).

The pore water target for hazardous compounds is equal to the Applied WQS as no Level 2 Dilution is taken into account (Step 4b).

2.3.6 *Step 5a – Calculation of Initial 10:1 L/S Ratio Leachate PLVs*

A pore water target is a theoretical concentration. Actual pore water concentrations in a recycled aggregate are not directly measurable and as such, leachate testing of solid samples is undertaken in order to provide an estimate of pore water concentrations. However, leachate concentrations are not directly comparable to pore water concentrations due to the following:

- Laboratory leachate testing typically uses deionised water which has a low dissolved ion content, whilst in nature leachates are derived from rainwater, which is slightly acidic and contains low levels of dissolved metals and inorganic constituents. The leachability of a determinand will be affected by the chemistry of the water.

- Laboratory leachate testing aims to evenly mix the solid sample and water by agitating or tumbling the samples. In nature, materials will not be agitated or evenly mixed and a portion of the aggregate's pore space will be bypassed by infiltrating rainwater and less leaching will result.
- Laboratories commonly estimate leachate results for 3 different eluent (leachate) to solid sample ratios as per European Standard EN 12457 (2002):
    - 0.2 L of eluent to 1 kg of solid sample (0.2 Liquid/Solid (L/S) Ratio) leachate test. Sometimes referred to as a 0.2 L/kg leachate test;
    - 2 L of eluent to 1 kg of solid sample (2:1 L/S Ratio) leachate test. Sometimes referred to as a 2 L/kg leachate test; and,
    - 10 L of eluent to 1 kg of solid sample (10:1 L/S Ratio) leachate test. Sometimes referred to as a 10 L/kg leachate test.

  In reality, the ratio of rainwater infiltration to aggregate will be different to this.
- For any material there is only a finite mass or amount that can leach out. Leachate concentrations are generally greatest when water first comes into contact with the solid material (e.g., the first pore volume) and then decreases over time as more infiltrating water passes through the aggregate (EU JRC 2014). The most commonly used laboratory leachate tests are run at a 10:1 L/S Ratio (e.g. standard WAC laboratory testing), which provides a measure of the effects of multiple pore volumes of water flushing through an aggregate.

Therefore, pore water target concentrations need to be converted to an equivalent leach test concentration which can then be used to screen against PLVs. Extensive research presented in EU JRC (2014) led to the development of an empirical relationship between pore waters and leach test concentrations used in the development of WAC criteria.

Calculated pore water targets have been converted to initial 10:1 L/S ratio leachate PLVs (units mg/kg) using equation 3.4 in EU JRC (2014):

$$LT = (PW/\mathrm{K})(1 - e^{-(L/S)\mathrm{K}} \qquad 1$$

Where:

- LT equals the leachate target in mg/kg
- PW equals the pore water target in mg/l
- L/S is the leachate to solid ratio of the soil-leachate test, in this instance 10:1 L/S
- K (or Kappa) is an empirical constant

The values of K utilised for each compound in this assessment are presented in Appendix C.

Calculated 10:1 L/S Ratio initial leachate PLVs concentrations (rounded to two significant figures) and expressed as mg/kg are presented in Table 2.3. Prior to these targets being set as proposed PLV they were compared against laboratory limit of detection and National and Industry Datasets (as detailed in Figure 2.1) to determine if they were suitable for use, as detailed in Section 2.3.8 and 2.3.9 and shown graphically in Appendix D and E.

Table 2.3 Calculated Initial Leachate PLVs (as 10:1 L/S Ratio Leachate (mg/kg))

Determinand	Calculated Initial Scenario A PLV	Calculated Initial Scenario B PLV
As	0.063	0.063
Ba	5.1	11
Cd	0.0074	0.0074
Cr Total	0.25	0.54
Cu	7.3	16
Hg	0.0057	0.0057
Mo	0.28	0.6
Ni	0.069	0.15
Pb	0.037	0.078
Sb	0.17	0.37
Se	0.15	0.32
Zn	0.33	0.71
V	1	2.2
Chloride	440	950
Fluoride	4.2	9.1
Sulphate	1,000	2,200
Phenol	0.037	0.079
DOC	180	400

2.3.7 *Step 5b – Calculation of Initial Total Concentration PLVs*

For consistency with current waste classification procedures, initial total concentration PLVs were derived for determinands for which inert WAC are defined as total (solid) concentrations. The determinands for which total concentration targets were calculated include BTEX compounds, Mineral Oil (TPH), PAHs and TOC.

Pore water targets (step 4a & 4b) for the organic chemicals of interest were converted to equivalent solid initial total concentration PLVs using EA (2006a) RTM equilibrium partitioning equations (Level 1 assessment). These calculations require assumptions to be made on both aggregate parameters (e.g., fraction of organic carbon, porosity & bulk density) and physio-chemical properties of the organic chemical (e.g., organic carbon partitioning coefficient (Koc) and Henry's Constant).

Given their potential use as engineering fill, Recycled Aggregate predominantly comprises sand and gravel, which are unlikely to have a large amount of organic carbon that would be more commonly associated with clay or silt containing materials. For the partitioning calculations, the bulk density and porosity properties published for the sand defined in Table 4.4 of the Environment Agency SR3 document (2009a) and a low fraction of organic carbon (foc) of 0.001 were assumed to be representative of Recycled Aggregate.

Physio-chemical properties for the organic compound groups of interest were taken from United Kingdom guidance (UK Environment Agency SR7 (2007) and LQM/ CIEH (2014)), except for PCB28 where the Koc value was taken from Waid (1986) and the dimensionless Henry's Constant has been conservatively assumed to be 0 in the absence of an available value. A full list of chemical input values is presented in Appendix C.

Total concentration targets for individual compounds and the selected target for each group are provided in Table 2.4 below. Calculated initial total concentration PLVs are generally low as the equilibrium calculation procedure conservatively assumes that all hydrocarbons present in a solid sample have the potential to leach out, which is unlikely to be the case. Prior to these targets being set as proposed PLV they were compared against laboratory limit of detection and National and Industry Datasets (as detailed in Figure 2.1) to determine if they were suitable for use, as detailed in Section 2.3.8 and 2.3.9 and shown graphically in Appendix D and E.

Table 2.4 Calculated Total Solid Concentration Targets for Individual Organic Compounds and Compound Groups

Compound of Interest	Calculated Initial Total Concentration PLV (mg/kg)	Compound Group	Group Initial Total Concentration PLV (mg/kg)
Benzene	0.0002	Total BTEX	0.0002
Toluene	0.2293		
Ethylbenzene	0.0069		
Xylenes	0.0065		
PCBs: PCB28	0.00041	PCBS (7 Congeners)	0.00041
TPH C10-C12	1.92	Mineral Oil	1.92
TPH C12-C16	40.60		
TPH C16-C35	4,317.84		
TPH C35-44	4,317.84		
PAH: Naphthalene	0.0009	Total PAH (17 including Coronene)	0.0009
PAH: Fluoranthene	0.0184		
PAH: Benzo(a)pyrene	0.0010		

An initial total concentration PLV for TOC was estimated to provide a mechanism by which the topsoil content of Recycled Aggregate can be managed. The proposed TOC value has been derived using the DOC leachate limits presented in Table 2.2, which enables both the solid (TOC) and liquid (DOC) values to be consistent.

A simple empirical relationship was applied to convert the DOC leachate target concentration into a TOC target concentration. The relationships between TOC and DOC were evaluated for two differing information sources:

- Under the Landfill Directive (2003/33/EC), inert WAC levels are published for DOC (as 10:1 leachate to solid ration leachate concentration) and TOC (as a solid concentration). The inert WAC for DOC is 500 mg/kg leachate and the inert WAC for TOC is 30,000 mg/kg (or 3 %). Therefore, empirically the TOC limit is 60 times the DOC limit. Applying this relationship to the DOC values presented in Table 2.3 resulted in initial TOC PLVs of 1.1% for Scenario A and 2.4% for Scenario B.

- A review of the Industry Dataset presented in Appendix E, indicated a ratio of 172 calculated when dividing the geometric mean TOC (mg/kg) by the DOC value (10:1 leachate to solid ratio leachate in mg/kg). This is approximately three times (3x) higher than the value obtained from inert WAC criteria. Using the ratio of 172 results in initial TOC PLVs of 3.1% for Scenario A and 6.9% for Scenario B. However, it should be noted that no clear correlation between TOC and DOC values was observed in the available dataset and calculated TOC to DOC ratios varied between 22 and 780.

Further assessment was undertaken to determine which of the four initial TOC PLV(s) were suitable for use as a proposed PLV(s). This is discussed in Step 6 and Step 7.

2.3.8 *Step 6 – Comparison of Initial Leachate PLV Against Existing Criteria and Laboratory Detection Limits*

The initial leachate PLVs presented in Table 2.3 have been compared against previously published criteria and laboratory limits of detection and are shown below in Table 2.5. The previously published criteria include inert landfill waste acceptance criteria (2003/33/EC) and End-of-Waste target criteria for aggregates including EU JRC 2014 and Hjelmar et al 2016 (Nordic EoW).

Table 2.5 Proposed Leachate PLVs compared against Published Criteria and Laboratory Limits of Detection

Determinand	Target Levels, All values for 10:1 L/S Ratio Leachate (mg/kg)							UKAS Accredited Laboratory Detection Limit, 10:1 L/S Ratio leachate (mg/kg)
	Initial Scenario A PLV	Initial Scenario B PLV	Inert Landfill WAC	JRC EoW (Unrestricted)	Nordic EoW (Unrestricted)	Nordic EoW (Road)	Nordic EoW (100m x100m x5m bund)	
As	0.063	0.063	0.5	0.037	0.0026	0.096	0.012	0.025
Ba	5.1	11	20	0.049	0.049	3.4	0.3	0.03
Cd	0.0074	0.0074	0.04	0.00017	0.000042	0.011	0.0067	0.005
Cr Total	0.25	0.54	0.5	0.094	0.0014	0.17	0.0128	0.015
Cu	7.3	16	2	0.041	0.041	29	1.69	0.07
Hg	0.0057	0.0057	0.01	0.0079	0.00004	0.0018	0.00021	0.0001
Mo	0.28	0.6	0.5	0.057	0.057	8.1	0.59	0.02
Ni	0.069	0.15	0.4	0.01	0.0034	0.55	0.037	0.02
Pb	0.037	0.078	0.5	0.0012	0.0012	0.83	0.048	0.05
Sb	0.17	0.37	0.06	0.012	0.012	0.49	0.06	0.02
Se	0.15	0.32	0.1	0.027	0.027	1.7	0.17	0.03
Zn	0.33	0.71	4	0.011	0.011	1.7	0.12	0.03
V	1	2.2	-	-	-	-	-	0.006
Chloride	440	950	800	280	28	580	106	3
Fluoride	4.2	9.1	10	6.2	6.2	200	28	3
Sulphate	1,000	2,200	1000	750	90	2,000	344	5
Phenol	0.037	0.079	1	0.33	0.33	-	-	0.1
DOC	180	400	500	15	15	340	56	20

The initial PLVs presented in Table 2.5 are generally less conservative than the recently published JRC (2014) and Nordic (Hjelmar et al 2016) End-of-Waste criteria but are, on the whole, similar to Nordic EoW for roads and lower than 2002 inert landfill WAC. The Nordic EoW criteria for roads and for 100m bunds have been generated for specific geotechnical uses which are similar to that proposed for PLVs.

As noted in Section 2.2, the 2002 inert landfill WAC considered unsaturated zone and saturated zone attenuation processes as well as Level 2 Dilution. Therefore, it would be expected that the inert landfill WAC would be higher than the proposed PLVs as they assume greater attenuation than that incorporated in the calculation of PLVs. However, proposed PLVs for the following determinands are higher than inert landfill WAC: Scenario B PLVs for chromium, molybdenum, chloride and sulphate along with proposed Scenario A and B PLVs for copper, antimony and selenium. This is due to a combination of reasons related to the use of less conservative WQS and different input criteria:

- Firstly, the applicable WQS for copper has increased since the generation of inert landfill WAC in 2002.
- Secondly, PLVs for antimony and selenium are based on the use of updated WHO (2017) health based WQS (refer to Section 2.3.3.), which are greater than the previous WQS.
- Thirdly, source areas and infiltration rates used for calculations estimate a marginally lower total recharge per unit time passing through the Recycled Aggregate source area in Scenario B compared to the total effective recharge passing through the landfill in inert WAC scenario adopted by Hjelmar et al, (2002). This means that the Level 2 Dilution factor for PLV Scenario B is likely greater than that assumed under inert WAC. Thus, for parameters with limited sorption capacity in the saturated and unsaturated zone, the initial Scenario B PLV may be greater than the WAC value.

Local industry data for recycled aggregates (summarised in Appendix D and E) indicates that for antimony, selenium and sulphate, natural leachable concentrations can often be above inert waste landfill WAC concentrations in aggregates. The elevated levels may relate to the presence of natural minerals that would also be present in virgin rock (see Section 5.4).

Notwithstanding the above, it is important to note that PLVs should not be used in place of WAC. Recycled Aggregate products passing PLVs are to be used in specific situations and should never be used in landfilling operations to infill any quarry or large void where WAC and specific risk assessments should apply. Large volume sources such as infilled quarries have the potential to generate a large volume of leachate and will represent a much higher risk to the water environment than the scenarios modelled to derive PLVs.

When compared against typical laboratory limits of detections available from commercial UKAS accredited environmental laboratories (refer to Table 2.5), it can be seen that proposed PLVs for most parameters are higher than commercially available detection limits. The exceptions to this are lead (initial scenario PLV-A is lower than a typical LOD of 0.05 mg/kg), and phenol (both initial scenario PLVs are lower than a typical LOD of 0.1 mg/kg). As such, the initial PLVs generally did not require further alteration. With regard to the lead PLV-A we recommend that this is amended to <0.05 mg/kg, and with regard to the phenol PLV-A and PLV-B we recommend that these are amended to <0.1mg/kg. The intent here is to indicate that these parameters should not be detected in the end product at current commercially-available detection limits, and that if in future lower detection limits are commercially-available that these PLVs should be reduced accordingly.

With regards the initial total (solid) concentration targets calculated for the organic chemicals, they are over an order of magnitude lower than typical UKAS accredited laboratory limits of detection, (refer to Table 2.6 below).

Table 2.6 Initial Total (Solid) Concentration Targets (S-PLVs) Compared Against Laboratory Detection Limits

Determinand	Calculated Initial Total Concentration PLV (mg/kg)*	UKAS Accredited Laboratory Detection Limit (mg/kg)**
Total BTEX	0.0002	0.025
PCBs (7 Congeners)	0.00041	0.035
Mineral Oil (C10-C40)	1.92	30
Total PAHs (17 including coronene)	0.0009	0.64

* Value is the lowest calculated for an individual compound in the group.

** Value is the detection limit for the determinand group, not individual compounds.

Where aggregates are derived from under or near an area of hydrocarbon contamination, from Made Ground or soils, or building/construction demolition materials, then detectable hydrocarbons could easily be present, and some form of screening criteria is considered necessary. After careful consideration the following practicable/pragmatic total concentration PLVs, termed S-PLVs for clarity, are proposed:

- For **Total BTEX,** a total concentration solid PLV of 0.025 mg/kg is proposed. This is equal to a typical UKAS accredited laboratory limit of detection (LOD) level for BTEX. Although, this is higher than the water environment risk based initial S-PLV, the use of LOD levels provides a mechanism by which to exclude samples that have detectable levels of BTEX, rather than all recycled aggregate samples being assumed to contain BTEX. Aggregate with non-detectable BTEX is highly unlikely to pose a significant risk to the water environment, especially considering that these compounds are typically readily biodegradable. The use of LOD levels also allows for future reduction in S-PLVs to potentially be adopted should laboratory detection limits reduce further. To provide some context to this proposed S-PLV, a comparison with Human Health general assessment criteria (GAC) for benzene has been undertaken. Of the BTEX compounds, benzene is considered to pose the greatest potential risk to human health. The LQM/ CIEH (2014) residential with homegrown produce consumption scenario Suitable 4 Use Level (S4UL) for 1 % soil organic matter GAC for benzene is 0.087 mg/kg, which is approximately 3.5 times greater than the proposed total BTEX S-PLV (assuming that it all comprises benzene). Therefore, any Recycled Aggregate with a concentration passing the PLV is not considered to pose a risk of adverse harm to human health, while aggregates with non-detectable BTEX are highly unlikely to pose a significant risk to the water environment.

- For **Mineral Oil (C10-C40)** a total concentration S-PLV of 50 mg/kg is proposed. This is a round number slightly higher than a typical UKAS accredited laboratory LOD limit of 30 mg/kg (see Table 2.6) and allows for trace levels of Mineral Oil which are often readily biodegradable or low mobility chemicals to be present in aggregate materials. There is also the potential for naturally occurring soil organic carbon to be inadvertently picked up by Mineral Oil analytical techniques. One further point to consider is that the Initial Total Concentration PLV for Mineral Oil is based on the current GTV of 7.5 µg/l derived from the former 10 µg/l standard which was based on taste/aesthetics rather than risk or toxicity. The lowest available risk based TPH WQS is the WHO (2008) drinking water guideline of 90 µg/l applicable for the TPH aromatic >EC10-12, >EC12-16, >EC16-21 and >EC21-35 fractions. The WHO (2008) values are promoted by CL:AIRE (2017) in guidance reviewed by the UK Environment Agency. This standard was identified as a possible alternate WQS given that the mineral Oil (C10-C40) may contain both low risk aliphatic and higher risk aromatic carbon bands fractions. However, following discussions with the EPA it was decided to use the current GTV as the WQS as the WHO (2008) values do not cover the entire Mineral Oil (C10-C40) range. Were the 90 µg/l WQS for TPH adopted, then this would increase the risk-based Initial Total Concentration for Mineral Oil (C10-40) by approximately a factor of 10 from 1.9 mg/kg to 23mg/kg, which is still below the current laboratory LOD. However, a much higher Initial Total Concentration can be calculated when adopting the WHO (2008) guideline value of 300 µg/l for Aliphatic TPH >C10-C12 and C12-C16 fractions (>EC8), but this was also not adopted because it would result in an initial Total Concentration that for some carbon bands would be above LQM/CIEH saturation limits of between 8.48 mg/kg and 48 mg/kg for TPH aliphatic bands in the Mineral Oil C10-C40 range. The proposed S-PLV of 50 mg/kg is lower than Human Health GAC for residential with homegrown produce consumption scenario S4ULs for all TPH fractions within the Mineral Oil C10-C40 range, which vary between 74 mg/kg and 65,000 mg/kg. As such, aggregate with concentrations of Mineral Oil up to 50 mg/kg is considered unlikely to pose a potential risk to human health and at worse a marginal short-lived risk to the water environment given that mineral oil constitutes are typically readily biodegradable and the higher chain length hydrocarbons in the fraction would have low mobility in groundwater (CL:AIRE, 2017). Increasing the PLV further was not considered appropriate because a Mineral Oil solid PLV greater than 50 mg/kg would unacceptably increase the potential for free phase hydrocarbons to be present within the Recycled Aggregate product.
- For **PCB (7 Congeners)** at total concentration solid PLV of 0.035 mg/kg is proposed. This is equal to a typical UKAS accredited LOD limit for PCBs (7 Congeners). Similar to the approach described above for BTEX, the use of a typical LOD provides a mechanism to exclude samples that have detectable levels of PCBs, rather than all recycled aggregate samples being allowed to contain PCBs. Aggregates with non-detectable PCBs are highly unlikely to pose a significant risk to the water environment. The use of a typical LOD also allows for future reduction in the S-PLV should laboratory detection limits reduce. A potential increase of the proposed S-PLV

above the LOD was not considered, due to potential human health risks and the absence of generic assessment criteria that are protective of human health. The LOD of 0.035 mg/kg is approximately 4 times lower than the United States Environment Protection Agency (2022) Residential Risk Based Screening Level of 0.12 mg/kg for PCB-118[3]. No PCB generic assessment criteria for PCBs are available in the Ireland or the UK. However, the LOD 0.035 mg/kg concentration, is (coincidently) approximately 4 times higher than the UK Environment Agency (2009a) residential soil guideline value of 0.008 mg/kg for PCDDs (polychlorinated dibenzo-p- dioxins), PCDFs (polychlorinated dibenzofurans) and dioxin-like PCBs (although, it is noted none of the PCB (7 Congeners) are classified as dioxin-like PCBs).

- For **Total PAHs (17 including coronene)** a total concentration solid PLV of 2 mg/kg is proposed. This is slightly higher than a typical UKAS accredited laboratory LOD of 0.64mg/kg (see Table 2.6). PAH compounds are characteristically low solubility compounds with low mobility in the water environment. As such, low soil detections are unlikely to pose a significant risk to the water environment and the PAH compounds will preferentially remain within the recycled aggregate materials. PAH detections in soil often represent a complex mixture of individual compounds, with the lower solubility, less mobile compounds often representing the higher risk potential to human health. The LQM/CIEH (2014) Suitable 4 Use Level (S4UL) for 1 % soil organic matter GAC for individual PAHs protective of Human Heath under a Residential with Homegrown Produce Consumption end use varies between 0.24 mg/kg for dibenzo(ah)anthracene to 2,400 mg/kg for anthracene. Given that PAHs in soil typically comprise a mixture of compounds, it is likely that dibenzo(ah)anthracene would comprise less than 10 % of the mixture of PAHs contained in an aggregate. Therefore, total PAH concentrations of 2 mg/kg or less are considered unlikely to pose a potential risk to human health or the water environment.

For TOC, the typical UKAS accredited laboratory limit of detection for organic carbon is 0.02 %. However, the review of the Industry Dataset presented in Appendix D indicated laboratory limits of detections up to 1 % are utilised (No TOC data was collected in the National Dataset). The initial PLVs for TOC estimated in Step 5b (Section 2.3.7), range between 1.1 % and 6.9 % and are above these detection limits and are also similar to the inert WAC target for TOC of 3 %. Based on this review, all the provisional screening targets for TOC presented in Section 2.3.7 were considered suitable for use and they are evaluated further in Step 7 below (Section 2.3.9).

2.3.9 *Step 7 – Comparison of Targets Against Industry Dataset, National Dataset and Laboratory Trial Dataset*

As part of this project, two laboratory analysis datasets were provided to the EPA and made available for review:

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[3] PCB-118 is the only one of the 7 PCB Congeners tested to have a US EPA screening level.

- An Industry Dataset (statistical summary presented in Appendix D) provided by aggregate producers including laboratory chemical analysis leachate and total concentration data from samples they have on file for aggregate materials. This dataset comprised analysis results from 781 leachate samples and 906 total concentration samples from 72 sites. These data were available for the following aggregate types:
    - Concrete (unground), i.e., tested as received by the laboratory (46 samples)
    - Concrete (ground or unknown if ground), i.e. potentially crushed by the laboratory prior to analysis (78 samples)
    - Mixed Construction and Demolition Material (24 samples)
    - Natural Rock By-Product (not from a quarry, recovered from processed soils) (545 samples)
    - Waste Stone (61 samples)
    - Natural (Virgin) Aggregates (15 samples)
    - Waste Soil and Aggregate (13 samples)
- A National Dataset (statistical summary presented in Appendix E) provided to the EPA by local authorities included total analysis leachate and total concentration results from 45 samples from 9 different sites. This dataset covers the following aggregate types:
    - Concrete (unground), i.e., tested as received by the laboratory (30 samples)
    - Mixed Construction and Demolition and Stone Material (6 samples)
    - Quarry Stone (4 samples)
    - Natural (virgin) Aggregates (1 sample)

In addition, laboratory trials were undertaken by Geosyntec in coordination with the EPA and Element Laboratory, Deeside, UK, on 6 recycled aggregate samples collected from producers in the Leinster area. Two of the samples were from natural aggregates and four from concrete aggregates. For each of the six solid samples, 1 subsample underwent total concentration analysis (6 total concentration sets of results in total) and 7 subsamples underwent leachate analysis in duplicate (84 leachate sets of results in total). As detailed in Section 5.5 some leachate subsamples were tested as-received (no crushing or grinding), some of the solid subsamples were crushed to 95 % < 4 mm prior to leach testing, and some were ground to <0.2 mm prior to leach testing. Also, some of the leachate subsamples were generated and analysed immediately, and other solid subsamples were subject to controlled weathering experiments in the laboratory prior to leach testing. The full laboratory trial report is included in Appendix F with a summary in Section 5.5.

Assessment of Total Soil and Soil Leachate Results Against Proposed PLVs

The results from the three datasets have been screened by aggregate type against the proposed PLVs. For each aggregate type, concentration distribution plots are presented in Appendix D (for the Industry Dataset) and E (for the National Dataset) for determinands which have been detected above their laboratory limit of detection and above either the leachate PLV-B or the total concentration PLV.

Full data from the laboratory trials is presented in Appendix F, with tables of data screened against leachate PLVs and total concentration PLV. For the majority of samples, determinand concentrations are either below respective laboratory limits of detection or proposed leachate PLV-B or solid S-PLVs. In most cases for a given determinand, only a small number of samples (less than 10% of the total Industry Dataset plus National Dataset) are shown to exceed the proposed leachate PLV-B or the total concentration S-PLV for a given determinand. This screening suggests that for the majority of Recycled Aggregate products, the use of the proposed PLV-B values will likely not represent a hurdle to their reuse and at the same time they provide a mechanism to screen out high concentration outliers likely indicative of contamination and associated potential risks to human health or the environment.

Notable results from the datasets review for each aggregate type are summarised as follows:

Concrete (unground) samples

- Industry Dataset: Mineral Oil concentrations greater than the S-PLV of 50 mg/kg were measured in 6 out of the 32 samples, with a maximum value of 265 mg/kg recorded.
- National Dataset: 7 out of 30 samples analysed for Total Petroleum Hydrocarbons (>C5-C44) had concentrations greater than the Mineral Oil S-PLV of 50 mg/kg, with a maximum concentration of 1,200 mg/kg recorded. All TPH exceedances from the National Dataset came from locations where either organic material, 1% timber and plastic or residual vinyl material was identified in the aggregate material. From the same locations that TPH exceedances were identified, 6 exceedances of the sulphate leachate PLV-B of 2,200 mg/kg were measured, with concentrations up to 15,000 mg/kg recorded. All other recorded sulphate leachate concentrations within the dataset are less than the lower PLV-A value of 1,000 mg/kg. The Total PAH solid S-PLV of 2 mg/kg was exceeded in 4 out of 30 samples with three of these being from the same location where wood (up to 3 %) was identified in aggregate materials. This data highlights the importance of removing impurities from Recycled Aggregates.
- Laboratory Trials: Chromium exceedances of the leachate PLV-A of 0.25 mg/kg were observed for 2 out of 4 concrete aggregate samples that were tested as received (with no crushing or grinding). Mineral Oil solid concentrations greater than the S-PLV of 50 mg/kg were measured in 3 of the concrete aggregate samples with a maximum concentration of 519 mg/kg recorded. In one of the samples with elevated Mineral Oil concentrations plastic impurities (<1 %) were identified, with no impurities observed in the other samples. The presence of Mineral Oil may reflect the presence of concrete additives within the samples (see Section 5.2). In one of the concrete aggregate samples the Total PAH solid S-PLV was exceeded, with a concentration of 7.05 mg/kg recorded, which may reflect contamination within source materials.

Concrete (ground) samples

- Industry Dataset: A Mineral Oil concentration greater than the S-PLV of 50 mg/kg was only measured in 1 out of 43 ground concrete samples, at 130 mg/kg. Total PAH concentrations above the solid S-PLV of 2 mg/kg were observed in 4 out of 33 samples, all from the same stockpile (max 6.3 mg/kg) and are considered likely to reflect low-level contamination in this stockpile.

- National Dataset: No sample of this aggregate type in the dataset.
- Laboratory Trials: Exceedances of the chromium PLV-A of 0.25 mg/kg were identified in 3 out of 4 concrete samples for both crushed and ground samples, with a maximum concentration of 0.822 mg/kg recorded. Exceedances of the chromium PLV-B of 0.54 mg/kg were recorded in 2 of the concrete samples for ground samples. Chromium is considered likely to be naturally present within concrete (see Section 5.3). The laboratory trials showed that chromium has a higher potential to leach from concrete aggregates when the aggregate is crushed or ground prior to analysis increasing their surface area to volume ratio, and also that the potential for chromium to leach tends to decline over time when the Recycled Aggregate is exposed to the elements.

Mixed Construction and Demolition Material

- Industry Dataset: A higher proportion of exceedances was identified in the mixed C&D material dataset as compared to concrete (unground) material, with greater than 10 % of samples exceeding PLV-B for total chromium, sulphate, phenol and zinc. This is considered to reflect the higher potential for additional materials to be present in mixed construction/demolition materials such as paint, vinyl flooring and insulation board. The dataset indicates that such materials have the potential to contain polluting substances.
- National Dataset: The dataset contains 6 Mixed C&D Material Samples, all from the same site. In these, the Total PAH solid S-PLV was exceeded in one sample.

Rock By-Product

- Industry Dataset: Less than 10% of the total samples tested from this material type (natural rock by-product recovered from processed soils) contained concentrations that exceeded PLV-B or s-PLV. The most frequent exceedances of PLV-B were recorded for sulphate with 17 out of 525 analysed samples (3 %) exceeding.
- Laboratory Trials: Two natural aggregates recovered from processed soils were included in the trials. A single fluoride exceedance of PLV-A was identified in a sample that had been ground prior to leach testing, out of a total of 28 samples tested for the two natural aggregates.

Quarry Rock

- National Dataset: Only a relatively small data set comprising 5 samples from quarry rock and natural aggregate were available and only 1 exceedance of PLV-B was recorded for arsenic.

Waste Stone

- Industry Dataset: For Waste Stone a total of 6 out of 51 samples contained Total PAH concentrations greater than the proposed PLV of 2mg/kg. It should be noted that Total PAH concentrations were below laboratory limits of detection in the majority of samples tested.

Identified exceedances of the proposed PLV are considered to reflect contamination within the aggregate material.

- National Dataset: No samples of this aggregate type in the dataset.

Waste Soil and Aggregate

- Industry Dataset: For this aggregate type, 7 of the 12 samples recorded arsenic leachate concentrations above the proposed PLV-B. However, all these sample came from the same source site. In addition to this, total PAH concentrations greater than the proposed Total PAH S-PLV were measured in 10 out of 18 solid samples. These exceedances may reflect contamination of the soil. This dataset suggests that there is a higher potential for Waste Soil and Aggregate to fail PLVs. Should there be a need to use these materials as Recycled Aggregate product, then further bespoke assessment should be considered with an aim of screening out contaminated material prior to processing.
- National Dataset: No samples of this aggregate type in the dataset.

The review of the datasets has identified some exceedances of the proposed PLV, however, these do not reflect the majority of the samples. Exceedances of the proposed PLV often may reflect the presence of impurities (including wood, soil, organic matter, plastic) within Recycled Aggregate that could result in potential adverse harm to the environment.

Exceedances of the Mineral Oil S-PLV of 50 mg/kg were recorded in 17 out of 108 concrete aggregate samples tested across datasets. Many of these exceedances were marginal and only 7 samples recorded concentrations Mineral Oil greater than 200 mg/kg. Results from the laboratory trials suggest that when Mineral Oil concentrations are detected in concrete aggregates they may be reflective of immobile hydrocarbon admixtures added to the original concrete mix rather than leachable contamination. In view of this, an amendment to the Mineral Oil S-PLV is proposed that will allow aggregates with low levels of non-leachable Mineral Oil to be used as Recycled Aggregate, as described below.

Aggregates where Mineral Oil has been detected are considered to pass a secondary S-PLV for Mineral Oil of 200 mg/kg, provided all leachate concentrations of TPH fractions within the Mineral Oil band are below laboratory method detection limits. This rule should not be applicable when aggregates are used for an allotment or residential end-use (i.e. only the primary S-PLV of 50 mg/kg should apply for these land uses). This secondary 200 mg/kg S-PLV for Mineral Oil is lower than all LQM/ CIEH (2014) 1% SOM S4ULs for public open space and commercial scenarios for TPH bands within the Mineral Oil range (i.e. 3,800 mg/kg to 1,600,000 mg/kg), therefore Mineral Oil concentrations up to this limit are not considered to pose a potential risk to human health. Applicable leachate laboratory limits of detection for a 10:1 leachate test are considered to be <0.05 mg/kg for TPH >C10-C12 aliphatic and aromatic bands, and <0.1 mg/kg for all other TPH aromatic and aliphatic bands within the Mineral Oil range.

TOC Target Assessment

TOC data is only available from the Industry Dataset. A summary of the provisional TOC targets screened against this dataset is presented in Table 2.7 below.

Table 2.7 Comparison of Provisional TOC Screening Targets Versus Industry Dataset

TOC to DOC Conversion Factor	Initial Leachate DOC PLVs (10:1 L/S Ratio Leachate)		Calculated Initial TOC PLVs		Screening of TOC Industry Dataset Number of Samples that exceeded calculated TOC value/ Total number of samples
	Scenario	(mg/kg)	(mg/kg)	(%)	
60 (From Inert WAC)	A	180	11,000	1.1	119/736 (16 %)
	B	400	24,000	2.4	20/736 (2.7 %)
173 (From Industry Dataset)	A	180	31,000	3.1	9/736 (1.2 %)
	B	400	69,000	6.9	0/736 (0%)

This comparison shows that using TOC targets calculated from the empirical relationship derived from inert WAC leads to small number (2.7%) of materials failing the Scenario B target and a higher proportion (16%) the Scenario A target. If the TOC targets derived from the Industry Dataset empirical relationship are used, then very few samples (1.2%) are identified to fail the Scenario A target, and none fail the Scenario B target.

A check was undertaken against typical soil organic carbon content values to determine whether the use of the provisional targets would prevent soil being used in Recycled Aggregate materials. An EPA assessment on the soil organic carbon content of Irish soils (2009) identified that the mean organic carbon content of peat soils varies between 37.7 and 43.6 % and the mean organic carbon content of peaty gley and podzol varies between 6.55 % and 27.7 %. It is considered important to limit the potential presence of peat and peaty soils in Recycled Aggregate, as the compressible nature of peat will likely make these aggregates geotechnically unsuitable. A Recycled Aggregate containing 10 % peat would have a TOC of c. 4 % and pass the provisional Scenario B TOC target of 6.9 % calculated from the Industry Dataset empirical relationship. A Recycled Aggregate containing 10 % of very peaty gley or podzol could have a TOC of c. 2.5 % and pass the provisional Scenario A TOC target of 3.1 %, again calculated from the Industry Dataset empirical relationship. Given that it is considered inappropriate for these types of soils to be present within Recycled Aggregate product, the 3.1% and 6.9% targets were dropped and not considered further.

Appendix D presents Industry Dataset TOC content distribution plots plotted against the proposed Scenario A target (1.1 %) and the Scenario B target (2.4 %), derived from the Inert WAC.

A large portion of data was identified to exceed the Scenario A TOC target of 1.1 % and the use of this target may prevent a large portion of material (including rock by-product) being used in Scenario A settings. Industry Dataset Scenario A target TOC exceedances were identified in ground concrete

(30 % of samples), rock by-product (14% of samples), waste stone (31 % of samples) and for mixed waste soil and stone (50 % of samples). High levels of TOC measured in rock and waste stone may relate to natural organic carbon in mudstone and siltstones rather than the presence of soil matter, peat or possibly hydrocarbon contamination. For concrete, detected TOC may relate to the presence of organic hydrocarbon-based additives within the concrete mix (see Section 5.2) which may be immobile. It should be noted that leach test analysis of both Industry Dataset and the National Dataset samples indicated no exceedances of proposed PLV-A for DOC. The leach testing DOC results suggest that the solid TOC contents are not readily leachable. Soil, stones and concrete make up the bulk of reused construction and demolition materials in Ireland (EPA, 2021). The use of the Scenario A target for TOC may adversely affect the circular economy, whilst providing limited benefit in protection of the environment.

Limited exceedances of the 2.4 % Scenario B TOC target are identified for ground concrete, rock by product and waste stone, with just 2.7% of samples exceeding. These exceedances are considered outliers which may indicate the possible presence of peat and/or other humic materials that may compromise the geotechnical properties of the aggregate. It is considered appropriate to screen out such materials using PLVs for this reason, rather than high TOC indicating a potential risk to the water environment.

Following this review of data, it has been agreed with the EPA to apply 2.4 % as the TOC total concentration S-PLV for use for both Scenario A and Scenario B.

3 PROPOSED POLLUTANT LIMIT VALUES

3.1 Use of PLVs

Geosyntec have derived proposed PLVs and associated technical guidance to help recycled aggregate producers determine whether their products meet criteria set out in Statutory Instrument No. 126 of the Regulations i.e., to not pose a risk of adverse harm to human health or the environment.

Assumptions that underpin the derivation of the proposed PLVs include the following:

- Producers must derive Recycled Aggregate product from waste included within the list of allowed wastes presented in Appendix B.
- Producers shall consider the potential for contaminants to be present in the source material based on the historical use of the site from which the source material was received, and if necessary, confirm through sampling and laboratory testing that the source material is not contaminated.
- The Recycled Aggregate product should not be derived from contaminated material or be derived from a known contaminated source, unless the recovery operation or prior treatment is capable of reducing contaminants to acceptable levels.
- The Recycled Aggregate product is assumed to be used for the purpose of fill or capping, which may, or may not, be covered by hardstanding (e.g. concrete or tarmacadam).

- PLVs represent an environmental specification and not an engineering specification.
- The PLVs are **not** the same as WAC and are **not to be used** as an alternative to WAC for assessing designated waste materials.
- Recycled Aggregate cannot be used in situations where it will be placed within saturated strata (e.g. below the groundwater table or in contact with surface water). The PLVs are only applicable to situations where the recycled aggregate is used within the unsaturated zone - i.e., above the groundwater table.
- If the intended use of the recycled aggregate is within a residential setting, allotment, or a public open space in a residential setting, and the product will be exposed at the surface, or as topsoil in homegrown produce growing areas, then screening against additional S-PLVs for arsenic and lead is required.
- If the intended use of the recycled aggregate is at a location where there is potential for surface run-off of water directly to a surface water body, current guidance on the design and installation of drainage systems shall be followed (see Section 4.1).

Proposed PLVs have been generated for two end-use scenarios as detailed in Table 3.1 below. The proposed use for a recycled aggregate must fit into one of these two scenarios.

Table 3.1 Proposed Pollutant Limit Value (PLV) Scenarios

	Scenario A PLV	**Scenario B PLV**
Conditions of use	**These PLV apply to Recycled Aggregate to be used in:** 1. Areas of open ground (no hard standing or building will be present), and with: • Extreme groundwater vulnerability; **or** • High groundwater vulnerability; **or** • Moderate groundwater vulnerability where less than 1m of low permeability (<0.001m/d) clay is present below the aggregate. 2. Areas of open ground (no hard standing or building will be present) directly underlain by a sand and gravel aquifer, or other shallow geology that can represent a viable aquifer.	**These PLV apply to Recycled Aggregate to be used in:** 1. Areas where hard standing will be present; **or** 2. Areas of open ground, with: • Low groundwater vulnerability, or • Moderate groundwater vulnerability, where at least 1m of low permeability (<0.001m/d) clay is present below the aggregate.
Notes: 1. The groundwater vulnerability of a location, and/or whether a sand and gravel aquifer is present at a location, to be identified from (a) GSI maps available free to view at https://gis.epa.ie/EPAMaps/; and/or (b) site specific data showing a shallow geological material that can represent a viable aquifer. 2. Site specific data or literature may be used to assess the presence of low permeability clay in a Moderate groundwater vulnerability zone, to justify the use of Scenario A values. 3. Refer, in addition, to exclusion distances from sensitive receptors (Table 3.3) and limitations on the extent of the application spreading area (Table 3.2).		

The PLVs have been generated assuming that Recycled Aggregate will be spread across a set area, up to 100 m long in the direction of groundwater flow and is adopted for the calculation of attenuation by dilution within underlying groundwater (refer to Section 2.3.4). This 100 m long size is considered a reasonable balance between the possible range in application sizes for Recycled Aggregate and the concentration level defined for the calculated PLV. Application areas greater than 100 m long in the direction of groundwater flow are likely to only be undertaken at a relatively small number of sites. PLVs calculated for a larger application area would be lower due to leaching over a wider area and these would restrict more materials from possible use in small (<100m) area applications, which are likely to dominate the use of Recycled Aggregate. Conversely, PLVs calculated for a smaller area would be higher and more practical to use, however, they would not fit many real-life scenarios and would not be applicable to schemes applying the aggregate to larger areas. Additionally, it is deemed impracticable to define multiple PLVs for differing scheme sizes which would be more complicated for users to follow and could lead to confusion. Thus, it is considered that a balance has been reached between small and large schemes that allows the derivation of practical PLVs for a spreading area that is functional for industry.

If it is proposed to place Recycled Aggregate over a distance greater than 100m in one direction, then it is recommended that there is a minimum separation distance of 25m between individual areas of Recycled Aggregate. This is consistent with the recommended separation distance for groundwater abstraction wells, the intent being that any mild leachate plume arising from an area of Recycled Aggregate is likely to have dissipated within this distance, therefore the requirement for this separation distance should prevent cumulative effects on groundwater quality. This separation distance shall not apply to linear features (e.g. road and railway embankments), on the basis that such features are unlikely to be closely aligned with groundwater flow direction over an extended distance.

There is no restriction on the thickness of placement of Recycled Aggregate; this is because thickness of the material does not affect the degree to which constituents within the Recycled Aggregate will leach from the material into groundwater directly after emplacement.

Table 3.2 below provides a summary of scenarios for which PLVs are intended to be used and scenarios where PLVs are not recommended for use. Additional risk assessment is recommended if the intended use of recycled aggregate does not match one of the categories for which PLVs are applicable (e.g. quarries/pits etc. that were part of a former extraction or waste management business).

Table 3.2 Extent of Application – Allowed and Disallowed Uses

Extent of Application – Allowed Use of PLVs	Extent of Application - Disallowed Use of PLVs
Any square or rectangular area (e.g., a car park, open storage area, mound etc.) up to 100 m wide in any direction. A minimum separation distance of 25 m shall apply if it is proposed to place Recycled Aggregate over distances greater than 100 m in one direction. This separation distance does not apply to roads and linear features (see below).	Infilling of any former quarry, pit or mineral excavation related to mining.
Any road or linear feature (e.g., bund, railway line). Assumed that the road or linear feature is <50 m wide.	Any road or linear feature (e.g., bund, railway line) over 50 m in width.

Extent of Application – Allowed Use of PLVs	Extent of Application - Disallowed Use of PLVs
Short or narrow tracks on private land, including forestry and agricultural land. The majority of these tracks are expected to be narrow (<5m wide) and relatively thin.	As growth medium in areas used for food production or livestock grazing. Ground cover in areas where sensitive ecological species are present either as a statutory defined area or identified by a competent suitably qualified ecologist (not including access tracks).
Commercial, industrial and public open space (park) land uses. Material may be exposed or not exposed at the surface. Residential (with and without homegrown consumption of produce), allotment or public open space (residential area) land uses where material meets additional arsenic and lead S-PLVs	Residential (with and without homegrown consumption of produce), allotment or public open space (residential area) land uses where material will be exposed at the surface or in produce plant uptake areas. where material does not meet additional arsenic and lead S-PLVs.

3.2 Exclusion Distances

Recycled aggregate cannot be used in areas or close to adjoining surface water, groundwater abstraction points for human consumption or sensitive groundwater/surface water features. Exclusion distances within which recycled granular aggregate cannot be used are summarised in Table 3.3 below.

Table 3.3 Exclusion Distances for Allowed Use of Pollutant Limit Values

Receptor	Exclusion Distance (m)	Justification
Abstraction point (either licensed or private) for any groundwater well or spring used for human consumption	25	• The higher abstraction rate of a water well the less likely it is to be at risk due to higher levels of dilution. • Passing PLVs should mean groundwater is safe for human consumption, having an exclusion distance provides an extra safety factor.
Any natural surface water, spring, lake shoreline, turlough likely to flood, exposed cavernous or karstified limestone features.	10	• High pH levels, dissolved metals and fine particulates/silt from recycled aggregate/concrete leachate have the potential to impact aquatic ecology. • Use of PLVs and exclusion distances dependent on strict use of management practices to reduce/ prevent run-off, removing risk at the source (see Section 4.2). • Exclusion distance limits potential for leachate from recycled aggregate/ concrete to run-off directly to surface water, in case management practices do not fully prevent the generation of run-off. • Exclusion distance limits the potential for accidental release of recycled aggregate/ concrete directly into surface water. • Exclusion distance also protects any spring or surface water where an abstraction is present for human consumption from impact from fines.
Recycled aggregate is likely to pose a lower risk to water environment receptors than that posed by agricultural applications of organic fertiliser and wastewater due to the lack of pathogens. Such agricultural applications are made to large areas many of which will be greater than the assumed application size adopted in the generation of PLVs. Additionally, PLVs have been calculated to be protective of water environment, either at the point of entry (for hazardous chemicals) or immediately after entry into groundwater for non-hazardous chemicals). Therefore, the lower range stand-off distances proposed herein are consistent with or conservative when compared to the distances outlined in:		

Receptor	Exclusion Distance (m)	Justification
• European Union (Good Agricultural Practice for Protection of Waters) Regulations 2022, S.I. No. 113 of 2022. • EPA 2021, Code of Practice, Wastewater Treatment and Disposal Systems Serving Single Houses (p.e.≤10). For fertiliser application, the proposed stand-off varies between 25 to 200m for drinking water abstraction points and between 5 to 20 m for surface water features.		

3.3 Proposed PLVs

The proposed PLVs are summarised in Table 3.4 and Table 3.5 below.

Table 3.4 Proposed 10:1 L/S Ratio Leachate Pollutant Limits Values (PLVs) for Recycled Aggregate Products

Compound	Target Levels, all values are in mg/kg	
	Proposed PLV-A	Proposed PLV-B
As	0.063	0.063
Ba	5.1	11
Cd	0.0074	0.0074
Cr Total	0.25	0.54
Cu	7.3	16
Hg	0.0057	0.0057
Mo	0.28	0.6
Ni	0.069	0.15
Pb	<0.05	0.078
Sb	0.17	0.37
Se	0.15	0.3
Zn	0.33	0.71
V	1	2.2
Chloride	440	950
Fluoride	4.2	9.1
Sulphate	1000	2200
Phenol	<0.1	<0.1
Dissolved Organic Carbon	180	400

Table 3.5 Proposed Total Concentration Solid Pollutant Limits Values (S-PLVs) for Recycled Aggregate Products

Compound	Proposed S-PLV
Total Organic Carbon	2.4 %*
Total BTEX	0.025 mg/kg
PCBs (7 Congeners)	0.035 mg/kg
Mineral Oil (C10-C40)	50 mg/kg**
Total PAHs (17 including coronene)	2 mg/kg
Chromium VI	2 mg/kg***
Arsenic	40 mg/kg****
Lead	310 mg/kg****

* Total Organic Carbon is a measure of all carbon with a sample including, but not limited to, plant and animal matter, wood, coal or ash and hydrocarbons.

** If the Mineral Oil (C10-C40) S-PLV is exceeded the aggregate is still considered to pass proposed PLV as long as all the following conditions apply: A. it is not to be used for a residential or allotment end use, B. solid Mineral Oil (C10-C40) concentrations are less than 200 mg/kg and, C. leachable concentrations of all speciated total petroleum hydrocarbon criteria working group (TPH-CWG) fractions within the Mineral Oil (C10-C40) range are below laboratory methods detection limits. Applicable 10:1 L/S Ratio laboratory method detection limits that should be met are:

- 0.05 mg/kg: TPH Aliphatic (>C10-C12), TPH Aromatic (>C10-C12)
- 0.1 mg/kg: TPH Aliphatic (>C12-C16), TPH Aliphatic (>C16-C21), TPH Aliphatic (>C21-C35), TPH Aliphatic (>C21-C44), TPH Aromatic (>C12-C16), TPH Aromatic (>C16-C21), TPH Aromatic (>C21-C35), TPH Aromatic (>C21-C44).

*** This is not calculated as a new PLV and applies to Recycled Concrete Aggregates only. Requirement of REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation (2006) for cement. The 2 mg/kg CrVI REACH criteria is protective of human health (construction workers) and is considered appropriate to apply to the handling of Recycled Concrete Aggregate Product for the same reasons. Refer to Section 5.3 for further discussion of chromium.

****Arsenic and lead S-PLVs only apply when the proposed end use of the Recycled Aggregate will be in a residential setting or public open space adjacent to a residential setting.

3.4 Compliance Sampling

Producers must undertake sampling and analysis to verify that a Recycled Aggregate output from the recovery process is compliant with the PLV criteria. It is important that leachate testing is undertaken on the as-sampled Recycled Aggregate, i.e., that the samples are not ground by the laboratory prior to analysis. Grinding of material will increase the surface area to volume ratio of the particles and increase the potential for leaching to occur. Therefore, analysis of ground samples could overestimate the leachable concentration of compounds from the product. Further investigation on this aspect is currently being undertaken by the EPA and the findings and its potential impact upon PLVs will be reported in 2023.

Recommended compliance sampling and analysis requirements are summarised in Table 3.6 below.

Table 3.6 End-of-Waste Sampling and Analysis Requirements

Stage	Applicability	Sampling Frequency	Analysis Required
End-of-Waste, Verification testing on output recycled aggregate	• For each new source of waste material processed or repeat batches for a given source. • For any alteration of the source of waste material processed, including but not limited to a change of source location or a change in waste code. • For each batch of waste that underwent treatment to reduce contaminant concentrations, prior to processing into aggregate. • For each batch of waste that underwent physical processing, prior to processing into aggregate.	• Minimum of one composite sample to characterise any new product batches or when the waste material source changes (including contaminated material that has undergone remediation). Sample to comprise of 3 sub-samples. • An Additional verification sample to be taken at least every 2,000 tonnes, comprising 3 sub-samples.	**Testing to include as a minimum:** • 10:1 L/S Ratio Leachate Analysis – Parameters in Table 3.4 plus pH • Solid Analysis – Parameters in Table 3.5 Testing shall also include any additional parameters of concern not included within the End-of-Waste PLV suite (based on history of sites from which source material was obtained).

Producers must undertake and document the sampling undertaken and the screening of leachate and total concentration data against applicable PLVs. The proposed sampling protocols outlined in this section are in keeping with procedures already in place to meet the requirements of WAC. If the recycled aggregate does not meet the PLVs, then potential options are:

- Determine that the material is unsuitable for use and is a waste; or,
- Undertake further processing/treatment of the output material.

Testing should be undertaken at an accredited laboratory with detection limits where possible below the PLVs (refer to Table 2.5 and 2.6 for typical UKAS accredited laboratory LODs). Where this is not possible, an audit trail should be kept to show that the lowest available laboratory detection limit has been used.

If for a given batch of samples, where the lowest available detection limit of a compound is greater than the PLV, but all compound results are below the laboratory detection limit, then it should be considered that there are no exceedances of the PLV. However, if a single sample in a batch exceeds a particular laboratory limit of detection and hence the PLV, then the material cannot be deemed to pass requirement 28(1)(a)(iv) of End-of-Waste regulations for the generic application scenarios considered in this document.

In some situations, as well as using the PLVs to determine whether a product is suitable to use, it may be necessary for producers of the aggregate to also further consider potential risks to surface water, human health and ecology, as discussed in Section 4.

4 OTHER FACTORS IN THE DETERMINATION OF POTENTIAL RISKS

This section summarises further considerations (in addition to passing PLV criteria) that users of Recycled Aggregate need to make when determining the suitability of use for a product for use at a particular site.

4.1 Risk to Surface Waters

As noted in Section 3.2, users of Recycled Aggregate need to be aware of and comply with the proposed exclusion distance of 10 m from a natural surface water body for the placement of Recycled Aggregate (refer to Table 3.3). This exclusion distance has been adopted in order to reduce potential risks from either groundwater migration or surface run-off derived from Recycled Aggregate. In so doing, the exclusion distance will add a further level of mitigation above than afforded by the proposed PLVs and help manage particulates for which no PLV has been determined.

There are two main pathways in which leachate from Recycled Aggregate could possibly reach a natural surface water feature (e.g. stream, spring, river, pond, estuary etc.):

- Groundwater migration
- Surface run-off

As outlined in Section 2, a balanced but relatively conservative approach has been adopted for the derivation of PLVs, which are primarily based on the groundwater migration pathway. This approach allowed for a relatively conservative level of dilution of leachate into underlying groundwater (refer to Section 2.3.4). As noted in Section 2.1, additional attenuation processes for groundwater migration are available for some determinands, including retardation, precipitation out of solution, biodegradation and dispersion. In addition to these, any dissolved phase determinands in groundwater will need to pass through what is known as the hyporheic zone in order to enter a surface water body (this does not apply to a groundwater fed spring). The hyporheic zone is a layer of sediment at the base of a surface water (sometimes a few centimetres to over a metre thick) in which the surface water and groundwater mix and there is potential for enhanced sorption and degradation of contaminants (UK Environment Agency 2005, 2006b). Groundwater dissolved phase determinands that passes through this zone will potentially undergo additional attenuation before dilution and mixing, as groundwater enters the surface water body. These additional attenuation steps will provide further mitigation above that offered by the proposed PLVs and aid in safeguarding surface water features.

Surface water run-off is potentially a much quicker pathway than groundwater migration and can represent a potentially more significant pathway for leachate or fines (suspended sediment) derived from Recycled Aggregate, especially if it is deposited on low permeability soils/substrata and/or sloping topography. To mitigate such risks, the placement of Recycled Aggregate near natural surface water bodies/features should abide by the proposed 10 m stand-off distance and also comply with appropriate guidance to minimise the potential for run-off to be generated. In situations where a surface water drainage system, including soakaways, is required to manage run off generated from the placement of Recycled Aggregate, then this needs to be appropriately designed to mitigate risks. The Irish Government Building Regulations 2010, Technical Guidance Document H: Drainage and Waste Water Disposal and the Dublin City Council "Sustainable Drainage Design & Evaluation Guide" (2021) provide good practice guidance for designing drainage systems.

Use of appropriate construction techniques to minimise the potential impact to surface water during construction is also required. It is recommended that Recycled Aggregate be considered as a potential contamination source within an Environmental Impact Assessment, where relevant for large projects.

4.2 Risk to Human Health

Potential risks to human health from Recycled Aggregate may be present when materials are handled by workers, or following placement at or near the surface in areas where direct contact pathways (e.g. ingestion, dermal contact, dust inhalation) with a potential human receptor are viable. Potential risks from handling of aggregate by workers should be mitigated through use of appropriate work control procedures, including the use of appropriate PPE. Example post deposition scenarios where exposure could potentially occur include on forestry tracks where workers and recreational users may be present; in an outdoor storage area on an industrial site; and a residential driveway or ground cover.

Potential risks may also be present to human health if Recycled Aggregate is placed in an area (either as a subsoil, or mixed within topsoil, or deposition of dust generated from the aggregate) where produce grown for human consumption is planted. Plant roots have the potential to draw up contamination into edible produce or topsoil. For this reason, the use of Recycled Aggregate either as a topsoil or mixed within topsoil has been identified as an exclusion.

When Recycled Aggregate is used as sub-base and is covered by surface materials (e.g. asphalt or concrete) the potential for materials to cause harm to human health is reduced. In this scenario potential risks human health can only exist via indirect vapour inhalation pathways between the Recycled Aggregate and a potential human receptor (e.g. vapours from organic substances migrating into buildings). The proposed PLVs for these volatile substances are low and, as such, they are unlikely to be present in Recycled Aggregate at concentrations that could pose a risk to human health.

4.2.1 Human Health Screening of Industry Analytical Data

Basic screening was undertaken of analytical data provided by industry data (summarised in Appendix D) and national data collected by local authorities (summarised in Appendix E). The data was screened against generic assessment criteria (GAC) protective of human health. This was undertaken in order to determine whether Recycled Aggregate has the potential to pose a risk to human health and whether additional screening of Recycled Aggregate total concentration data against human health GAC was needed to determine whether the products are suitable for use.

Human Health GACs were taken from 2014 Suitable 4 Use Levels (LQM/ CIEH). Land use types considered included residential (including scenarios with and without consumption of homegrown produce), public open space (residential area), public open space (park) and commercial scenarios. An allotment scenario was not specifically assessed because risks identified for a residential (with homegrown produce consumption) setting are also considered to apply to an allotment setting. Where no S4UL (LQM/ CIEH) GAC was available then the following criteria were adopted:

- For lead a UK Category 4 Screening Level (DeFRA 2014) was used.
- For antimony, molybdenum and total cresols a CL:AIRE (2010) GAC was used.
- For Total PCBs a UK Environment Agency (2009b) Soil Guideline Value was used

Total (solid) concentration analytical data provided by Industry is summarised in Appendix D, while National Dataset collected by local authorities is summarised in Appendix E. For the majority of the Industry Dataset samples, only total mineral oil and total PAH concentrations were available, whilst for the National Dataset speciated compounds were available.

Identified exceedances of Human Heath GAC are summarised below.

4.2.2 Concrete

A total of 118 samples from the Industry Dataset and 33 samples from the National Dataset were screened against published GAC. Although it is noted that not all samples were analysed for all determinands. The total number of samples analysed per determinand is stated below where relevant for all aggregate types.

- Inorganics or metals: no exceedances of inorganic or metal GAC were identified except for lead in two samples. The exceedances for lead are summarised as follows:
    - In one sample (out of 24 analysed for lead) from the Industry Dataset 666 mg/kg was recorded which is above the GAC protective of residential (200 mg/kg with consumption of homegrown produce and 310 mg/kg without consumption of homegrown produce) and Public Open Space (Residential Scenario) (630 mg/kg).
    - A single lead exceedance of GAC was identified in the National Dataset, where 33 samples were analysed for lead, with 340 mg/kg recorded. This is above both the residential end use GACs (e.g. 200 and 310 mg/kg).
    - In the other 55 samples analysed across both datasets, lead concentrations were recorded at 150 mg/kg or less and below all GAC.
    - The identified exceedances of lead GAC are considered may reflect naturally occurring lead within aggregate, or reflect fragments of metal or rebar in the concrete being included within a laboratory analysis sample.
- Organic determinands: in the National Dataset, exceedances of hydrocarbon GACs protective of human health were only identified in one sample (out of 33 tested). A TPH aliphatic >C8-C10 concentration of 76 mg/kg was recorded compared to a residential (with and without homegrown produce consumption) GAC of 27 mg/kg. In the same sample a TPH aromatic >C21-C35 concentration of 1,800mg/kg was recorded, above the residential (with homegrown produce consumption) GAC of 260 mg/kg but below the residential (without homegrown produce consumption) GAC of 1,900 mg/kg. In this sample timber and plastic were identified

to be present. This sample was one of two taken from the same stockpile with no TPH detected in the second sample.

- In the Industry Dataset no speciated analytical data was available for TPH other than the more broad-spectrum Mineral Oil (C10-C40) suite. Mineral Oil concentrations up to 265 mg/kg and Total PAH concentrations up to 6.3 mg/kg were recorded. It should be noted that no GAC are available for both non-speciated total PAH and total TPH. However, given that these Industry totals are similar to the totals from the speciated National Dataset, for which no exceedances were identified, would suggest a similar pattern for the Industry Dataset. Thus, it is considered likely that no exceedances of individual TPH fraction or PAH compound GAC protective of human health would be anticipated for the Industry Dataset.

Apart from very isolated lead and TPH exceedances noted above, the majority of concrete samples in the datasets were not identified to pose a potential risk to human health.

4.2.3 Mixed Construction and Demolition Fill

No exceedances of GAC protective of human health were identified for all 7 samples from the National Dataset, which comprised speciated analysis. In the 23 samples analysed for total concentrations from the Industry Dataset, analysis was limited to un-speciated hydrocarbons. Mineral Oil concentrations up to 295 mg/kg were recorded, which are similar to the speciated total concentrations measured in the National Dataset where no exceedances of GAC protective of human health were identified (when speciated data is assessed).

4.2.4 Rock By Product & Quarry Stone

A total of 552 rock by-product samples from the Industry Dataset and 4 quarry stone samples from the National Dataset were screened against GAC. No exceedances of GAC were identified in the speciated National Dataset.

From the Industry Dataset the following results were obtained:

- Organics: No speciated analysis was undertaken for this dataset. Mineral Oil concentrations up to 399 mg/kg and total PAH concentrations up to 23.6 mg/kg were recorded. As noted above, no GAC are available for both total PAH and total TPH. However, given that these Industry totals are similar to the totals from across the entire speciated National Dataset (for all aggregate types) for which no exceedances were identified would suggest a similar pattern for the Industry Dataset. Thus, it is considered likely that no exceedances of individual TPH fraction or PAH compound GAC protective of human health would be anticipated for the Industry Dataset.
- Inorganics: 9 out of 544 samples analysed for arsenic recorded concentrations above its residential (with homegrown produce consumption) GAC of 37 mg/kg, with 8 of these also above its residential (without homegrown produce consumption) GAC of 40 mg/kg. A maximum concentration of 78 mg/kg recorded. In 4 out of 543 samples analysed for cadmium, concentrations were present above the residential (with homegrown produce consumption)

GAC of 11 mg/kg, with a maximum concentration of 23.6 mg/kg recorded and no samples exceeding the residential (without homegrown produce consumption) GAC of 85 mg/kg. No exceedances GAC protective of human health under public open space or commercial scenarios were identified. The presence of arsenic and cadmium within rock is considered likely to be natural in origin.

4.2.5 *Natural Aggregates*

A total of 15 samples from the Industry Dataset and 1 sample from the National Dataset was screened against GAC, with no exceedances identified.

4.2.6 *Waste Stone*

A total of 54 waste stone samples from the Industry Dataset were screened against GAC. No waste stone samples were available in the National Dataset.

Industry Dataset results can be summarised as follows:

- Organics: non-speciated Mineral Oil concentrations up to 1,755 mg/kg and total PAH concentrations up to 13.6 mg/kg were recorded. As noted above, no GAC are available for both non-speciated total PAH and total TPH. With the exception of the 1,755 mg/kg mineral oil result (next highest was 171 mg/kg), the Industry totals are similar to the totals from across the entire speciated National Dataset (for all aggregate types), for which no exceedances were identified, would suggest a similar pattern for the Industry Dataset. Thus, it is considered likely that no exceedances of individual TPH fraction or PAH compound GAC protective of human health would be anticipated for the Industry Dataset. However, that said, the 1,755 mg/kg Mineral Oil sample result is considered to be an outlier and, as a result, potential risks may be present to human health from this sample.
- Inorganics: Three very marginal exceedances of the arsenic GAC protective of a residential (with homegrown produce consumption) scenario (37 mg/kg) were recorded in 3 out of 54 samples analysed for arsenic, with a maximum concentration of 40 mg/kg. In 51 samples analysed for total PCBs two samples exceeded the residential (with homegrown produce consumption) GAC of 0.008 mg/kg and one sample with a concentration of 3.8 mg/kg exceeded the commercial GAC of 0.24 mg/kg. These exceedances would suggest the presence of contaminated soils/stone within this material.

It is uncertain where the waste stone presented in the Industry Dataset originated from. Identified exceedances could relate to some of this material being recovered from a contaminated site.

4.2.7 *Waste Soil and Stone*

A total of 17 waste soil and stone samples from the Industry Dataset were screened against GAC, of which 12 were analysed for speciated petroleum hydrocarbons. Total PAH concentrations of 34 mg/kg were recorded. Exceedances of individual PAH compound GAC protective of residential (with and without consumption of homegrown produce) scenarios were identified in 3 of 12 samples with benzo(a)pyrene (3.9 mg/kg max), benzo(b)fluoranthene (4.6 mg/kg max), dibenzo(ah)anthracene (0.56 mg/kg max) and naphthalene (4.8 mg/kg max) the contaminants of concern. An exceedance for lead was measured in one of 15 samples analysed, with a concentration of 260 mg/kg, which is above the residential (with homegrown produce consumption) GAC of 200 mg/kg. The identified exceedances are considered most likely to reflect waste soils recovered from contaminated sites.

4.2.8 Summary and Recommendations

The laboratory analysis of Recycled Aggregate materials has identified that low levels of hydrocarbons (mineral oil and total PAHs) are reasonably common, however, screening against human health GAC indicates that in the vast majority of cases, these are likely to be lower than GAC and will not represent a risk to human health. This conclusion is based on total Mineral Oil and PAH concentrations from the Industry Dataset being similar to the totals derived from speciated analysis undertake for the National Dataset. The Industry Dataset comprises non-speciated analysis for mineral oil and PAH, for which no GACs are available, but they are available for individual compounds determined by speciated TPH and PAH. It has been assumed that both data sets will comprise similar materials and as such similar chemical compositions.

As discussed in Section 2.3.8, the proposed total concentration S-PLVs for hydrocarbons are set at levels similar to human health residential screening criteria. To limit the potential for a Recycled Aggregate to fail a PLV due to Mineral Oil or total PAH concentration, it is recommended that any noticeable organic constituents (e.g. wood, asphalt, plastic etc) are removed where possible from the aggregate.

For inorganic determinands, isolated predominantly marginal exceedances of GAC protective of residents are observed for lead in concrete, lead in waste soil and stone, arsenic in waste stone and arsenic and cadmium in rock by-product (as discussed in detail above). A single exceedance of the GAC protective of a Public Open Space (Residential) scenario was identified for lead in concrete. These exceedances relate to either some contamination or from naturally occurring constituents, because they were also recorded within natural (virgin) stone aggregates. Prior to using a recycled aggregate at the surface or in areas that produce is grown within a residential, allotment or Public Open Space (Residential) setting it is recommend that in addition to screening against PLVs and S-PLVs, imported materials are screened against S-PLVs for arsenic and lead to ensure that they are suitable for use.

At one location within waste stone a total PCB concentration of 3.8 mg/kg was recorded, which is over 10 times higher than its commercial screening criteria. The reason for this exceedance is unclear but does suggest that materials were sourced from a contaminated site or sites. The appropriate screening of aggregate materials against total concentration S-PLVs will help minimise the presence of contaminated materials within the Recycled Aggregates and be protective of human health and the water environment.

4.3 Risk to Ecology

Where Recycled Aggregate is used in situations where they will be exposed at, or near the ground surface, in addition to posing a potential risk to human health, they may also pose a potential risk to ecology (e.g., plants, birds, mammals, invertebrates and bacteria in the soil). The UK Environment Agency (2022) has published soil screening values for assessing ecological risks. These screening values define limits below which no adverse effects are expected to flora, fauna or the microbial function of soils. The EA (2022) screening values are often very low, for example the cadmium ecological GAC is 0.6 mg/kg, which is lower than the mean cadmium concentrations measured in the Industry Dataset for all materials tested, including; concrete (0.64 mg/kg), virgin rock by-product (2.17 mg/kg) and natural aggregates (0.90 mg/kg). Additionally, mean zinc concentrations in all material types in the Industry Dataset were identified to be above the zinc ecological screening value of 35.6 mg/kg. The UK Environment Agency (2022) guidance accepts that natural background levels may be similar or higher than the derived ecological screening values. The UK Environment Agency (2022) guidance notes that a mechanism to address this issue could be the calculation of "added risk" screening values that are equal to the ecological GAC plus the ambient background concentration of a metal. However, this brings additional uncertainty into the derivation of a suitable ambient background concentration. Importantly, it is not known what proportion of the metals in any given material are in a bioavailable form (to living organisms). Given this uncertainty, the promotion of ecological screening values within the End-of-Waste guidance is not considered practicable at this stage.

Given the presence of metals within naturally occurring materials, the use of ecological screening values could mean uncontaminated natural materials being excluded from reuse. However, by ignoring potential risks to ecological receptors that may be posed by Recycled Aggregate could cause unintended risks to natural ecology, agriculture or livestock. The EA (2022) ecological screening values highlight that ecology has the potential to be adversely affected by even very low concentrations of metals. Therefore, a precautionary approach is recommended, whereby Recycled Aggregate products are excluded from use as a growth medium, as ground cover in areas of livestock pasture, or as ground cover in areas where sensitive ecological species are present. This exclusion does not incorporate tracks within forestry and agricultural land, on which living organisms are likely to spend only limited time. The determination of whether a sensitive ecological species is present should be identified through checking for locations of statutory defined ecological sensitive site or by a competent qualified ecologist.

5 FURTHER DISCUSSION

5.1 Alkaline Leachate from Concrete

Detailed reviews into high pH leachate derived from recycled concrete aggregate (RCA) are provided by Sanger et. al (2020), Chen et al (2020), Gupta et al. (2017). The reader is referred to these publications for full details, however, key points from these are summarised as follows:

- Existing laboratory investigations on freshly crushed RCA consistently measure high leachate pH, typically pH 10 to 12.5; while long-term highway field studies demonstrate that, after an initial phase of high pH, leachate approaches neutral pH within one to two years of construction or (importantly) stockpiling prior to use.

- The high pH of RCA leachate is derived primarily from the dissolution of carbonate and hydroxide species from cement exposed during the crushing process. On exposure to atmospheric carbon dioxide (CO_2) and humidity/or intermittent saturation, carbonates are formed at matrix surfaces which eventually forms a protective carbonate surface layer (or carbonated outer zone). This layer limits the mass transport and dissolution of calcium hydroxide into the leachate. This process is known as carbonation and leads to an eventual reduction in leachate pH. HazWasteOnline™ (2020) note that the pH of leachate from concrete could reduce by between 0.5 and 1 pH unit within 24 hours of exposure to the atmosphere, due to the process of carbonation.

- Laboratory samples can be ground to a powder for testing. Finer crushed concrete particles will have a higher surface area than coarse grained crushes, and as a result can produce and sustain higher pH leachate for longer. However, such fine grain sizes are not applied in the field and so leach testing results from crushed concrete may not be applicable to the coarser grained recycled aggregate materials actually used.

- RCA is often stockpiled before use which allows the carbonation process to commence prior to use. Studies have also found that generally, the noncarbonated, freshly crushed RCA samples exhibit leachate pH from 11.5 to 12.7 (Engelsen et al., 2009; Mulugeta et al., 2011), whereas the leachate pH of the carbonated samples ranged from 9.9 to 11.8 (Engelsen et al., 2009; Abbaspour et al., 2016; Mulugeta et al., 2011; Sanchez et al., 2002; Madras Natarajan et al., 2019; all in Sanger et al 2020). Stockpiling RCA before construction is a common practice and offers a potential method to carbonate RCA before use. The Minnesota Department of Transportation (MnDOT) investigated and characterized leachate from RCA stockpiles by monitoring two outdoor RCA stockpiles for 13 months: one of coarse, gravel-sized RCA and the other of finer material (Sadecki et al., 1996, in Sanger et al 2020). MnDOT found the coarse RCA to have pH between 8.5 and 10.9, median 9.8, while the leachate from the finer RCA was between 7.4 and 12.2, median 9.3 (Sadecki et al., 1996, in Sanger et al 2020).

- The difference in pH between freshly crushed and older carbonated RCA may also be an artefact of standard laboratory leach tests which often involve shaking or tumbling of freshly crushed samples which are in permanent contact with water. Such procedures promote agitation/abrasion and disturbance of RCA surfaces which inhibits the carbonation process and facilities high dissolution rates.

- Depending on the drainage design of a base course layer, water may be in contact with the RCA for as little as one or two hours, or longer than several days (AASHTO, 1993). Contact time is important in RCA leachate chemistry since longer contact times result in more mineral dissolution. Laboratory studies often maintain RCA to be in contact with water for extended periods of time, which often is not directly comparable with field situations.

- Field studies by Engelsen et al., 2006, 2012 and 2017 (all in Sanger et. al., 2020) indicate that asphalt-covered RCA demonstrated a smaller decrease in pH, from 12.7 to 11.5, in the initial 14 months of a study compared to uncovered RCA (exposed to rainfall), which decreased from 12.8 to 9.5 in the same time period. Leachate form the asphalt covered RCA eventually reduced to below pH after 2.5 years. Leachate from natural virgin aggregate road sections remained between pH 8 and 9 throughout the monitoring period (Engelsen et al., 2006 in Sanger et. al., 2020). Although smaller infiltration rates through RCA materials can lead to longer durations for high leachate pH, at the same time smaller infiltration volumes will percolate through the underlying unsaturated soils. Reduced percolation volumes could enable the attenuation capacity within the unsaturated zone via a combination of the carbonation process from CO_2 present in soil gas and neutralisation to have a greater effect on reducing infiltrating pH. Additionally, small infiltration volumes if able to enter underlying groundwater, would lead to greater dilution effects and lower pH loadings per recharge event (although extended over a longer period).
- It should be noted that the quoted pH in the scientific literature field studies often relates to leachate in contact with the RCA or base materials and not that which has migrated through an underlying soil column or natural strata, or which has entered deeper groundwater.
- Laboratory studies typically employ a constant input of high pH leachate, rather than a slug or pulses from a depleting (finite) source of high pH water. In the field, RCA materials are exposed to atmospheric CO_2 and would carbonise with time while only a drip feed of leachate would enter the unsaturated soils in response to rainfall percolation events. So, for typical applications of RCA in the field, no constant input of leachate will be generated, but rather a depleting source that drip feeds leachate in response to rainfall and is exposed to CO_2, so pH in the field would be expected to dissipate much more quickly than shown in laboratory studies.
- Gupta et al. (2017) applied soil column experiments to investigate soil-RCA leachate interactions and found that soil acidity can neutralize small volumes of RCA leachate pH, such that 1 m of subgrade soil has the capacity to neutralize RCA leachate for 20 years, disregarding the additional factors that reduce leachate pH (e.g., carbonation, groundwater acidity from bicarbonate and other dissolved species, and soil vapor carbon dioxide). As expected, alkaline soils offered less buffering capacity.
- Chen et .al. (2020) undertook column experiments using synthetic high pH (>12) leachate on a variety of natural soils. Simulations using low permeability clay rich (30%) soils indicated that it would take >30 years for pH at a depth of 5 m to rise above pH 8.5. While for a higher permeability (1.7 x10^{-7} m/s) predominantly quartz sand (59% of quartz) soil with only small amounts of Al-bearing clay minerals (14%), high pH migration is more rapid, and after <1 year the pH of the soil's pore water may exceed pH 8.5 at a depth of 5 m. The authors did note however, that the simulations included several worst-case assumptions including saturated soil media, continuous input of high

pH leachate, and lack of mixing of other fluids and does not include the effect of atmospheric CO_2 on reducing leachate pH. Changes in any of these factors could decrease the speed at which the high pH hydroxide front migrates and would depend on field conditions.

- Gupta et al. (2018) noted that if RCA leachate with an elevated pH were to reach an aquifer unit, dilution in the groundwater unit and associated water acidity will provide further neutralization. Gupta et al. (2018) when ignoring the aquifer rock minerals, groundwater acidity results from hydrogen and bicarbonate ions and carbonic acid. In most groundwater, the inorganic carbon species, bicarbonate ions, and carbonic acid, provide most of the neutralizing capacity. Gupta et al. (2017) undertook chemical equilibrium modelling (in the absence of aquifer rock matrix minerals) to assess the effects of dilution on pH reduction by a groundwater with a pH of 7.5, and alkalinities of 50, 100 and 200 mg/L. This modelling indicated that where dilution factors for infiltrating water onto groundwater ranged between 5 and 10, then pH reductions of between 0.5 and 1 pH units would occur in a low (50 mg/l) alkalinity groundwater, a pH reduction of between 0.5 and 2 pH unit would result, while for a high (200 mg/l) alkalinity groundwater, a pH reduction of between 1 and 2 pH units would result. So, relating these results to generic Irish aquifers (refer to Section 2.3.4 and Appendix A), high permeability limestone aquifers may be less susceptible to the generation of elevated pH groundwater from infiltrating leachate as a result of high dilution factors and high alkalinity. Conversely, low permeability aquifers with low dilution factors will commonly have more clay minerals present, so potentially will have greater mineral pH buffering capacity, so offsetting the lower dilution factors.

In summary, any high pH leachate generated by RCA concrete would be anticipated to decline on exposure to atmospheric CO_2 and will start to be neutralised by soil minerals as it infiltrates through unsaturated zone and then further attenuation would result from dilution within underlying groundwater. Field studies show that high pH leachate dissipates within a period of 1 to two years. Additionally, lab analysis procedures that involve crushing of the concrete are likely to not be representative of actual leachate from the courser grained RCA product actually used on site.

It is recommended that

- Freshly crushed RCA be stockpiled before use to allow for the carbonisation process to commence prior to use.
- Laboratory leach test analysis should be undertaken on "as received" concrete samples with no crushing prior to leaching.

5.2 Concrete Additives

Concrete is primarily a mix of water, natural stone and sand and cement. Additives are often mixed into concrete to improve its properties. The three main types of additives include plasticisers, hardeners and epoxy resins. A review was undertaken of these potential additives to assess whether the proposed PLVs and associated guidance was suitably protective of the potential risks posed to human health and the environment by the presence of additives in concrete.

5.2.1 *Plasticisers*

Plasticisers are added to the wet concrete mixture pre-application to increase the workability of the concrete mix[4]. The use of plasticisers reduces the amount of water needed to mix the concrete, allowing a higher overall strength. They work by acting as a lubricant between concrete molecules aiding mixing and can make up around 0.2 to 2 % of the concrete mass (by weight), based on data from available online material safety data sheets (reviewed sheets listed in Section 6). A review of material safety data sheets available online for commercial plasticiser products identified as being used in concrete indicated typical plasticiser ingredients to included >C10 to C16 chain length ethoxylated alcohols and amines, ortho phthalates, diethanolamine, diethanolamide and naphthalene sulphate. There is a potential for these compounds (if present) to leach out of RCA. Without applying more specialist analytical techniques, the possible presence of plasticisers could be identified indirectly by the Mineral Oil (or speciated TPH) analytical suites and possibly via the Total PAH suite. This would enable indirect screening of analysis results against S-PLVs. Total petroleum hydrocarbon analysis would determine whether diethanolamides, ortho phthalates, >C10 to C16 chain length ethoxylated alcohols and amines were present and Total PAH analysis would determine whether any naphthalene was present. Diethanolamines are expected to be quickly degraded (PubChem[5]) and unlikely to represent a significant risk driver to the environment or human health.

5.2.2 *Hardeners*

Based on a review of material safety data sheets for common hardeners (listed in Section 6) hardeners are applied to the top surfaces of concrete by painting or spraying in order to make the concrete less porous and harder wearing. They can also act as an adhesive for a covering to the concrete. The review also indicated the main ingredients to be silica or silicate often mixed with a cation to stabilise it. Silica is the main active ingredient in hardeners. When a hardener is applied to the concrete surface, silica reacts with the calcium hydroxide in the concrete to form a calcium silicate hydrate gel, which infills the pores on the surface of the concrete[6]. The review of material safety data sheets identified other hardener ingredients to include low levels of metal oxides and coal combustion residuals, that are added as colourants so that the hardener also acts as a paint and can contribute up to 10 % of the mix in the hardeners. These colourants comprise a low proportion of a very thin hardener (paint) layer on the surface of the concrete and on a weight by weight, bases are likely to comprise a very small proportion of the crushed concrete. As such, they would not be expected to contribute significantly to leachate concentrations of metals and organics when compared to that generated by the greater concrete mass itself. However, any hardener ingredients that may be present would be expected to

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[4] Designing Buildings website accessed December 2022:
https://www.designingbuildings.co.uk/wiki/Plasticiser

[5] Pubchem website accessed November 2022:
https://pubchem.ncbi.nlm.nih.gov/compound/8113#section=Environmental-Biodegradation

[6] Endurable Concrete Products website accessed December 2022
https://hdipinc.com/products/concrete-hardener/

be identified through appropriate analysis for metals and Mineral Oil which will enable indirect screening against PLVs.

5.2.3 *Epoxy Resin*

Epoxy resins are used to form a chemical resistant, waterproof and durable layer sprayed on the surface of concrete and typically form a layer a few mm to a few centimetres thick on the surface of the concrete and some entry into the concrete matrix may also occur. This chemically stable layer is a three-dimensional organic polymer structure. The epoxy resin is made from the reaction of two mixtures, a resin and a curer, which are supplied separately and mixed on site prior to applying to the concrete in thin layer(s)[7]. A review of available online material safety data sheets for epoxy resins (listed in Section 6) indicated that a wide range of potential organic compounds could be present within a given resin formula. A common ingredient in the resin mixture is epichlorohydrin[8] which reacts with other compounds within the resin mixture (e.g., bisphenol A, bisphenol F, amines, phenols and aliphatic compounds) to form long chain molecules (polymers). The curer mixture turns the long chain molecules into a three-dimensional structure. Chemicals within the curer can include anionic catalysts, amines, mercaptan, anhydrides and phenols. Other chemicals identified on material safety data sheets (may be present within resin or curer) include 2,4,6-Tri(dimethylaminomethyl)phenol, alcohols, acetates, formaldehyde, xylene, ethylbenzene, cresols, isocyanates, naphthalene related compounds.

It is important to note that the majority of the chemicals noted above are likely converted on curing into stable long chain polymer molecules, with only a small proportion of unreacted ingredients remaining within the impregnated concrete. Any unreacted volatile ingredients present within the impregnated concrete surface layer would likely volatilise and be lost as the concrete was crushed, exposed to the air and converted into RCA. However, non-volatile unreacted ingredients if present can be leachable and may contain hazardous compounds not included within the PLV analysis suite. A current scientific literature review (summarised below) was undertaken to determine whether organic compounds have the potential to leach from epoxy resin impregnated concrete, their potential toxicity and whether laboratory analysis is practicable.

A limited number of scientific studies into the assessment of leachate from epoxy resins and organics from concrete have so far been identified. Bundy et al (2017) analysed RCA samples from three recycling centres across Maryland, United States. Samples were analysed as collected, with no grinding undertaken prior to analysis. Samples were analysed for semi volatile organic compounds (SVOCs). It was decided not to analyse for volatile organic compounds (VOCs) as these were anticipated not to be present due to volatilisation from RCA stockpiles. All SVOC results were below the laboratory limit of detection with the exception of three PAHs (anthracene, fluorene and phenanthrene). Fluorene was recorded at the highest leachable concentration at 1.65 mg/kg in one

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[7] The Constructor: Building Ideas website accessed December 20222
https://theconstructor.org/building/epoxy-resin-repair-rehabilitation-structures/17010/
https://theconstructor.org/building/epoxy-flooring-types-laying/553054/

sample. The authors hypothesised that contamination may be due to accidental spillages on the road surfaces that the samples were collected from, rather than concrete additives, but this was not proven.

The presence in concrete of bisphenol A and phenol compounds, related to epoxy resins, has been the focus of a small number of studies. Bruchet et al (2014) undertook a leachate tank test on 10 concrete epoxy panels. Bisphenol A was recorded in the deionised tank water, but at a very low concentration of 0.09 µg/l, while 2,4,6 – trichlorophenol was also observed up to 0.07 µg/l. Lampea et al (2018) obtained an order of magnitude higher bisphenol A concentrations in two concrete sidewalk samples (up to 0.82 µg/l). However, it is important to note that these samples were ground prior to analysis, which likely increased the potential for leaching, as compared to the larger grain sized material when used as aggregate. Also, in this study nonylphenols were recorded up to 2.5 µg/l. Sakamoto et al (2007) recorded leachable bisphenol A at up to 9 mg/kg in two epoxy-resin pavement material samples, however, the analysis technique (including the leachate to solid ratio) used to get this value was not provided by the authors.

Bisphenol A is a common ingredient in epoxy resins and is a known endocrine disrupter (ECHA 2017b). The ECHA website[8] lists bisphenol A as having hazard class code Rep 1B. (May damage fertility/ suspected of damaging the unborn child) and therefore would be classified as Hazardous in Groundwater using EPA methodology (EPA, 2010). The current ECHA Point of No Exposure concentration protective of freshwater for bisphenol A is 18 µg/l. ECHA have also published on their website a methodology for estimating long term exposure toxicity limits for Bisphenol A for human health via an oral pathway[9]. From this a Bisphenol A drinking water limit protective of human health is estimated at 140 µg/l. When compared to the concentrations presented in the reviewed epoxy leachate studies, these ECHA criteria were exceeded by the results in 1 out of the 3 studies. Bisphenol A could be considered a substance of potential concern within epoxy resins. Although there is potential to analyse for bisphenol A at low levels (<0.01µg/l) in some specialist laboratories (Bruchet et al, 2014), this is not a typical analyte of potential concern and many commercial environmental laboratories may struggle to achieve a low enough detection limits that allows the determination whether a regulatory limit is exceeded or not in a sample.

The review has identified that there is the potential for some hazardous substances to be present within some concrete that have been treated with epoxy resins and that these may be leachable at low concentrations. Limited research is so far available for a relatively small number of compounds, and it is currently uncertain whether other uncharacterised leachable compounds within RCA may be

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[8] The ECHA website accessed November 2022: https://echa.europa.eu/search-for-chemicals?p_p_id=disssimplesearch_WAR_disssearchportlet&p_p_lifecycle=0&_disssimplesearch_WAR_disssearchportlet_searchOccurred=true&_disssimplesearch_WAR_disssearchportlet_sessionCriteriaId=dissSimpleSearchSessionParam101401671280422341

[9] Value derived assuming an adult body weight of 70 kg, an average water consumption rate of 2 L/day and using the ECHA oral exposure long term derived no effect level of 4 µg of contaminant per kg receptor body weight per day.

present. In view of this, therefore, a precautionary approach is recommended, whereby concrete known to contain epoxy resins are excluded from being used as Recycled Aggregate products.

5.3 Chromium Speciation in Concrete

Concrete consists of cement and ballast. Cement is manufactured through the processing of natural rocks such as quarried limestone, shale, silicate rocks and iron oxides. These are milled into fine powders before being heated to high temperatures in two stages. Preheating up to 900°C which burns off impurities and then heating up to 1,500°C. The calcium carbonate ($CaCO_3$) within the limestone is converted by the heat into lime (CaO) and carbon dioxide. Gypsum is then added to the mixture to control the settling of the cement.

Chromium is a natural trace element in rocks. Chromium III is the dominant form (or valance) of chromium in the environment. Chromium III is the reduced form of chromium and readily substitutes for iron (Fe II) . Commonly, in rocks which have a high iron concentration such as basic igneous rocks, shales and clays will also have associated chromium contents. However, chromium is also present at lower concentrations in silicate rocks and limestone (Hooda 2010). Average chromium concentrations in rocks are around 200 to 1,800 mg/kg in basic/ultramafic igneous rocks, 100 to 120 mg/kg in shales, black shales and clays, 35 mg/kg in sandstone, 20 mg/kg in granite and 10 mg/kg in limestone (Hooda 2010). During the second high temperature heating phase in the formation of cement, natural occurring trace Cr III is oxidised to the more toxic Chromium VI (Cr VI) (European Commission Scientific Committee on Toxicity, Ecotoxicity and the Environment (EC SCTEE) 2002). Chromium VI is identified by the ECHA website as having multiple hazard codes including Skin Corr. 1A (causes severe burns and eye damage), Carc. 1A (may cause cancer), STOT RE 1 (causes damage to organs through prolonged exposure) and Aquatic Acute 1 and Aquatic Chronic 1 (very toxic to aquatic life with long lasting effects).

In 2003 the European Union passed Directive 2003/53/EC limited the concentration of Cr VI in cement to 2 mg/kg, in order to reduce the risk of skin-based allergies to construction workers. Although this directive was superseded by the REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) legislation in 2006, the 2 mg/kg limit was kept. To achieve this Cr VI limit a reducing agent, such as ferrous sulphate hydrate, is typically added to the cement post-production to convert Cr VI generated back to Cr III (MPA Cement Factsheet 2007).

Based on the above, concrete produced prior to 2003 has the potential to have higher concentrations of Cr VI than concretes produced after 2003. Assuming concrete buildings are likely to last for more than 20 years, RCA currently being produced is considered more likely to come from concrete constructed prior to 2003. Therefore, there is the potential that Cr VI may be present in RCA, which has the potential to adversely affect the health of those handling the RCA product as well as other human health or environmental receptors.

Cr VI was analysed for in 32 ground concrete samples from the Industry Dataset with a maximum total concentration of 1.08 mg/kg being recorded which is below the 2 mg/kg REACH limit protective of construction workers. In the majority of these samples (27 out of 32) Cr VI was not detected above the laboratory detection limit of 0.6 mg/kg. Total chromium analysis provides a measure of both Cr III and Cr VI. Total chromium concentrations from the same samples were measured at between 3.55 and 29.2 mg/kg. In the Recycled Aggregate product National Dataset, Cr VI was detected in only 1 out of 28 samples at a concentration of 0.51 mg/kg, while total chromium concentrations between 2 and 14 mg/kg were recorded in this dataset. No empirical relationship between total chromium and Cr VI concentrations from a given sample was evident from both datasets. All Cr VI concentrations (above laboratory detection limits) in RCA from both the Industry and National Datasets were below the Human Health generic assessment criteria protective of a residential receptor (6 mg/kg) (LQM/CIEH 2014).

The analysis of the Industry and National Datasets suggests that Cr VI concentrations in concrete would not be expected to pose a significant risk to human health. However, this should not be taken for granted and all Recycled Aggregate product should by default comply with the REACH requirement of having a Cr VI total concentrations below 2 mg/kg.

Cr VI has a higher aqueous solubility than Cr III and as a result has a greater potential to leach from solid materials than Cr III. Therefore, even if low Cr VI total concentrations are present in solid material, this still has the ability to generate leachate with measurable Cr VI contents.

In the Industry Dataset leachable Cr VI was recorded above the laboratory limit of detection (0.3mg/kg) in 2 out of 31 concrete samples that were analysed for Cr VI with a maximum 10:1 L/S ratio leachate concentration of 0.397 mg/kg detected. The maximum leachable total chromium concentration out of 131 samples analysed for this was 0.63 mg/kg. Within the Industry and National Sampling datasets only 18 samples out of a total of 149 samples analysed have leachable total chromium concentrations above the proposed PLV-A (0.25 mg/kg) and only 3 samples have leachable total chromium concentrations above the proposed PLV-B (0.54 mg/kg). The data suggests that around 2 % of RCA would fail PLV-B.

The calculated PLVs are based upon a total chromium WQS of 37.5 µg/l, which is the Ireland GTV for total chromium. This has been set as 75 % of the WHO (2017) drinking water guideline of 50 µg/l. The WHO (2017) guideline was originally published in 1958 for Cr VI and was later changed to a total chromium value due to inaccuracies in the measurement of Cr VI. An Ireland GTV of 7.5 µg/l has also been published for Cr VI, which is based on a 2014 California drinking water Maximum Concentration Limit (MCL) of 10 µg/l (California Water Board, 2017)). This limit was invalidated in 2017 by the Superior Court of Sacramento County (California Water Board, 2017), postdating the publication of the Ireland GTVs in 2016. Therefore, use of the Cr VI GTV to derive PLVs was not considered suitable at this stage.

The use of the WHO (2017) drinking water guideline as a WQS to derive the PLVs is consistent with approaches adopted by other European Union states. If total chromium concentrations in leachate for a RCA are indentified above the PLV-B consideration should be undertaken to determine whether this is in the more mobile and toxic Cr VI form. The presence of Cr VI should be considered in further assessment to determine whether the aggregate is suitable for use as a product or classified as a waste.

5.4 Compounds of Concern in Rock By-Product

Proposed PLV-A and/or PLV-B are greater than published inert waste acceptance criteria (WAC) limits for barium, cadmium, total chromium, copper, antimony, molybdenum, selenium, chloride and sulphate. It was initially considered when deriving the PLVs to set an upper limit for PLV-A and PLV-B values as 75 % of the inert WAC limit for a given determinand to help ensure that the PLVs were not used for the disposal of non-hazardous waste. One of the main reasons why the 75% limit of WAC was not considered suitable was due to high leachable concentrations for naturally occurring antimony (Sb), molybdenum (Mo), selenium (Se) and sulphate from natural rock by-product materials (natural rocks present within processed soil) in the industry dataset. The use of the 75% limit would have prevented these natural rock materials from being used as recycled aggregates.

Antimony is typically associated with soils related to the sulphide bearing hydrothermal mineral stibnite (Teagasc and EPA, 2007) and its presence in many rock types may be related to orogenic minerals and processes (Young (Ed), 2016). Unfortunately, total (solid) antimony concentrations were not analysed for in the Industry Dataset virgin rock by-product materials. However, in the National Dataset antimony was not detected (all <2 mg/kg total concentration) in the 5 natural rock samples tested from quarries and aggregates.

In Irish soils, selenium concentrations greater than 1 mg/kg are typically recorded in areas of "impure limestone geology" such as Dublin, Meath, Westmeath, west Offaly, east Galway and North Tipperary, with lower levels in the south and east of Ireland ((Teagasc and EPA, 2007). High Selenium is also associated with shales with whole rock concentrations up to 40.5 mg/kg recorded in UK shales (Parnel et al 2019). The virgin rock by-product analysed in the Industry Dataset recorded a maximum selenium concentration of 20 mg/kg, with a geometric mean of 2.28 mg/kg. In the National Dataset in 5 analysed quarry rock and aggregate samples, a maximum concentration of 0.78 mg/kg was recorded.

Elevated molybdenum in Irish soils is typically associated with underlying granites, Namurian shales and shaley Carboniferous limestone (Teagasc and EPA, 2007). So high concentrations would be expected in these rock types. As a trace element, molybdenum is present in most rocks at around 1 to 10 mg/kg and can be found at particularly high concentrations, circa 100 mg/kg, in black shales and organic rich mudstones (Smedley and Kinniburgh 2017). The virgin rock by-product from the Industry Dataset recorded a maximum molybdenum concentration of 39 mg/kg, with a geometric mean of 5.51 mg/kg. In the National Dataset the 5 analysed quarry rock and aggregate samples tested recorded a maximum concentration of 0.9 mg/kg.

Sulphate is present within evaporite deposits (gypsum and anhydrite) and mudstones. In the UK Mercia Mudstone, median total sulphate contents of 0.39 % (3,900 mg/kg) have been recorded (British Geological Survey, 2002). Total sulphate concentrations were not analysed for in the natural rock by-product in the Industry Dataset. However, in the National Dataset in the 5 analysed quarry rock and aggregate samples, total sulphate concentrations of between 170 and 3,500 mg/kg were recorded. Although the source rocks are not known, the highest value may suggest a mudstone origin.

Full leachate and total concentrations statistics for the rock by-product from the Industry Dataset and the quarry rock and natural aggregate from the National Dataset are included in Appendix D and Appendix E respectively. The leachate geometric mean and maximum concentrations from the Industry Dataset are provide in Table 5.1 below. Also shown is the 75 % of the inert WAC limit, proposed PLV-B and the number of exceedances associated with each of these limits.

Table 5.1 Antimony, Molybdenum, Selenium and Sulphate 10:1 L/S Ratio Leachate Concentrations in Rock By-Product Materials in Industry Dataset

Compound	Geomean (mg/kg)	Maximum (mg/kg)	75 % WAC (mg/kg)	Exceedances of 75 % WAC	PLV-B (mg/kg)	Exceedances of PLV-B
Sb	0.035	0.47	0.045	173/525	0.37	1/525
Mo	0.173	1.53	0.375	67/525	0.6	5/525
Se	0.054	0.67	0.075	168/525	0.32	10/525
Sulphate	333	5,519	750	146/525	2,200	15/525

Note: 67/525 = 67 determinand exceedances of criteria from a sample population of 525

Leachate concentrations for antimony, selenium and sulphate exceed 75 % of the inert WAC limit in over 25 % of rock samples, while Mo exceeded this in over 10 % of rock samples. It is clear from Table 5.1 that if 75% inert WAC limits were used to define PLVs for these determinands then this would lead to a large volume of natural/clean rock by product being classified as not suitable for use a Recycled Aggregate product and potentially sent to a landfill. This therefore showed that the use of 75 % inert WAC limits to define PLVs was not appropriate.

As such, it was decided to derive risk based PLV values for these determinands based on available drinking water guidelines which are considered to be robust and protective of human health via consumption of groundwater. The WQS used to calculate the PLVs for antimony, molybdenum and selenium are health based WHO (2017) guideline values, while for sulphate the WQS is the Ireland GTV. Table 5.1 indicates that only isolated exceedances of the PLV-B (<5 % of the total samples) were identified for leachate concentrations from the Industry Dataset rock by-product. Any rock by-product with concentrations above the PLV-B is potentially unsuitable for use as Recycled Aggregate and may pose a risk to human health and the environment. Even though these elevated concentrations come from natural rock it is considered appropriate to screen out these natural aggregates and not allow them to be used as Recycled Aggregate. Moving a rock type to location where it did not originate from may impact upon local groundwater geochemistry. As described above, such effects where highlighted by Parnel et al (2019) where naturally occurring metals within shales have the potential to negatively impact upon human health and the environment.

The highest concentrations of molybdenum, selenium and sulphate in natural rock are typically associated with mudstones (British Geological Survey, 2002, Smedley and Kinniburgh 2017, Parnel et al 2019). The generally friable nature of this rock type may also potentially make it geotechnically unsuitable for use as a Recycled Aggregate product where geotechnical integrity is required.

5.5 Laboratory Trials

As part of this End of Waste technical guidance, Geosyntec undertook laboratory trials in coordination with the EPA and Element Laboratory, Deeside, UK. The full report for this study is provided in Appendix F. The overall purpose of the trials was to identify recommendations for the laboratory analysis and stockpiling of Recycled Aggregates and where appropriate to inform the derivation of the PLVs.

The trials were designed to enable:

- A comparison between the leachability of determinands from "as received" (non-crushed) samples and leachability of determinands from samples that undergo standard pre-analysis laboratory preparation (being crushed or ground) prior to undertaking the leachate test. The purpose of this trial was to assess whether laboratory preparation methods involving the crushing of recycled aggregate samples (or even on-site crushing of materials prior to shipping to the laboratory) increases the leachable contaminant concentrations (as compared to in non-crushed samples).
- An assessment of the effect of holding / stockpiling timeframes between aggregate generation and leach testing. It is noted from scientific literature that stockpiling for a period of time prior to use tends to lead to a reduction in leachate concentrations, but few examples have so far been presented on this. This assessment aimed to provide some insight into the effects of the duration of stockpiling on leachate concentrations from recycled aggregates (in particularly concrete recycled aggregates).

A total of 6 recycled aggregate samples (4 concrete and 2 natural aggregate) were collected by Geosyntec for the trials from stockpiles at three producer facilities in the Leinster area that had been left in stockpiles and exposed to the elements over different time periods. On receipt at the laboratory, each aggregate sample was split into 8 subsamples. One subsample was analysed for total solid concentrations, whilst the other 7 underwent leachate analysis. Analysis was undertaken for determinands with PLVs, common determinands in aggregates, plus speciated PAHs, total petroleum hydrocarbon fractions and semi volatile organic compounds (SVOCs). Leachate analysis for all inorganic and metal determinands was undertaken in duplicate.

Aggregate samples will sometimes be provided to laboratories in sample grain sizes too large for leachate analysis, therefore some level breaking up of the samples or removal of large particles will be taken pre leach testing. The trials investigated 3 different methodologies. Of the 7 solid subsamples selected for leach testing: 1 subsample was ground to <0.2 mm; 3 subsamples were crushed to 95 % <4 mm as specified in IS EN 12457; and, in 3 subsamples were analysed as-received on suitable sized grains (no crushing or grinding). The grains in the more ground/ crushed subsamples will have a higher surface area to volume ratio and hence a higher potential for leaching to occur.

Laboratory trials were also undertaken to assess the effects of weathering on leachate concentrations of determinands. For each of the 6 aggregate samples:

- The ground subsample plus 1 of the crushed and 1 of the hand selected subsamples were stored inside and were analysed within 7 days.
- 1 of the crushed and 1 of the hand selected subsamples were stored outside exposing them to the elements (atmosphere and rain) for 3 weeks post sample preparation and pre-leach testing.
- 1 of the crushed and 1 of the hand selected subsamples were stored outside exposing them to the elements (atmosphere and rain) for 6 weeks post sample preparation and pre-leach testing.

Collecting of samples from stockpiles that had been left outside for different amounts of time plus the above laboratory trials provided information to assess how leachate concentrations may be affected by weathering processes. Comparison of data collected from stockpiles and analysed immediately was undertaken to assess the "real-world" effect of weathering on leachate concentrations. The laboratory trials allowed an assessment of weathering effects in a more controlled setting.

Data from the laboratory trials was compared against proposed PLV-A, PLV-B and S-PLV values. The key results of this comparison are detailed in Section 2.3.9.

Key conclusions from the laboratory trials are summarised below:

- Crushing and grinding of aggregate samples in the laboratory prior to analysis creates fresh mineral surfaces and increases the ratio of surface area to volume of grains. Leachable concentrations were greater in samples that had been crushed or ground for total chromium, chromium VI, barium, calcium, copper, molybdenum, nickel, potassium and chloride. A preparation procedure that includes crushing or grinding could therefore lead to an overestimation of leachable concentrations in Recycled Aggregate. To obtain representative estimates of leachability, it is recommended that aggregate samples are tested "as received" by a laboratory and not crushed or ground prior to analysis.
- pH of leachate from concrete and natural aggregates is likely to reduce over time as an aggregate in a stockpile is exposed to the elements (rain and the atmosphere), which promotes carbonation of particle surfaces. In the laboratory trials, a drop of pH of approximately 1 pH unit was measured over a period of 6 weeks exposure time to the elements. When comparing the pH of leachate from samples collected from producer stockpiles as part of this study, compositional variation of the concrete was identified to be the main driver for pH readings in concrete, and the results with regard to stockpile age were less clear. There is no proposed PLV for pH.
- Leachable concentrations of chromium, chromium VI, chloride, barium, calcium, potassium, copper, molybdenum, nickel and zinc from aggregate samples decreased with the time that leachate subsamples were exposed to the elements in the laboratory trials. Reduction in leachability is likely linked to mineral precipitation and sorption of metals related to the carbonisation process. A similar trend was not observed with regard to samples taken from stockpiles at aggregate producer facilities, except for chloride.

- Leachable concentrations of vanadium from aggregate samples were identified to increase the longer that leachate subsamples were exposed to the elements in the laboratory trials. However, the vanadium concentration in all leachate subsamples remained below the proposed PLVs.
- Low levels of antimony and arsenic were identified in solid subsamples and leachate subsamples, with no exceedances of proposed PLVs identified. No observable pattern in leachate concentrations for these determinands were identified with material type, sample preparation or exposure time.
- Aluminium was identified at elevated concentrations in solid samples and leachate samples, likely related to the presence of natural minerals in ballast material or concrete additives. There is no proposed PLV for aluminium. No observable patterns in leachate concentrations for aluminium were identified with material type, sample preparation or exposure time.
- Total Organic Carbon and Dissolved Organic Carbon were not identified at concentrations exceeding the proposed S-PLV or PLVs, respectively. No observable pattern in leachate concentrations were identified with material type, sample preparation or exposure time.
- Leachable sulphate concentrations for natural aggregates were not identified above proposed PLVs, but they were for concrete aggregates (refer to following point). No observable patterns in leachate concentrations were identified with material type, sample preparation or exposure time. Sulphate concentrations were identified to vary between duplicate samples by up to 200 %, the reason for which is not clear.
- Exceedances of proposed PLVs in leachate were identified for three determinands: fluoride, sulphate and chromium:
    - Only one exceedance of the fluoride PLV-A value was measured for a natural aggregate subsample that was ground to a fine powder and leached directly after preparation, out of a total of 84 leachate subsamples (including duplicates) for the 6 aggregate samples. This value was below the fluoride PLV-B.
    - For chromium, exceedances of the PLVs were only identified from concrete aggregate samples, and the more that a subsample was ground/ crushed prior to analysis the higher the chromium concentration recorded. Increasing exposure time to the elements resulted in fewer exceedances of the chromium PLV in leachate subsamples, with no exceedances of PLVs observed in leachate from samples exposed to the elements for 6 weeks. In total, 19 exceedances of the PLV-A and 4 exceedances of the PLV-B were identified across a total of 56 leachate subsamples (including duplicates) for the 4 concrete aggregate samples. Failures of PLV-A were identified in 3 out of 4 concrete aggregate samples and failures of PLV-B were identified in 2 concrete aggregate samples. Exceedances of PLV-B were only identified in ground samples.

  - For sulphate, PLV exceedances were observed in 3 out of 4 concrete aggregate samples and neither of the 2 aggregate samples. In subsamples exposed to the elements for 6 weeks, only a single exceedance of the sulphate PLV-A was identified. In total, 8 exceedances of the PLV-A and 2 exceedances of the PLV-B were identified across a total of 56 leachate subsamples (including duplicates) for the 4 concrete aggregate samples.

- Based on the above, determinand leachate concentrations in aggregate samples which are tested “as-received” by the laboratory (not crushed or ground prior to analysis) are more likely to be below PLVs as compared to leachate from crushed or ground samples. Laboratory experiments suggest that the potential for leachate concentrations to exceed PLVs may be reduced by exposing aggregate stockpiles to the elements for a period of weeks post-crushing, and prior to testing.
- TPH analysis on solid samples reported Mineral Oil concentrations above the S-PLV in 3 out of 4 concrete aggregate samples. However, no petroleum hydrocarbons were detected above laboratory method detection limit in the respective leachate samples. It is also noted that only 14 out of 105 concrete samples from the National and Industry Datasets (summarised in Section 2.3.9) exceed the S-PLV. The data suggests that TPH may often be detected in Recycled Aggregate produced from concrete, and that there may be potential for frequent exceedances of the S-PLV for Mineral Oil. If it is the case that frequent exceedance of the Mineral Oil S-PLV is observed by producers, then an option the EPA could consider would be to allow a higher concentration of Mineral Oil in the aggregate, provided it is shown through leach testing that the Mineral Oil is not leachable. This proposed option is detailed in Section 2.3.9.
- No petroleum hydrocarbons were detected in natural aggregate solid or leachate samples.
- Individual PAH compounds were identified in 3 out of 4 concrete aggregate solid samples and in 1 out of 2 natural aggregate samples. An exceedance of the total PAH S-PLV was only identified in a one concrete aggregate sample. This compares to 4 exceedances of the S-PLV out of 62 concrete aggregate samples in the National and Industrial datasets. Trace levels of individual PAHs were detected in all leachate subsamples, with no clear trends observed with regard to subsample preparation (crushing/grinding) or with regard to time of exposure to the elements.

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Additives in Concrete Review

Type of Additive	Product	Company	SDS Link
Plasticiser	CEMENTONE MORTAR PLASTICISER CEMPLAS	Bostik	http://www.free-instruction-manuals.com/pdf/p4775223.pdf
Plasticiser	CEMENTONE MORTAR PLASTICISER	Bostik	https://www.bostik.com/files/live/sites/shared_bostik/files/Images/United%20Kingdom/Products/C%26C/30812466_MTR_UCLP_BE.pdf
Plasticiser	MaxMix Mortar Plasticiser	Sika	https://www.dwnye.co.uk/storage/lcf-media/bs004-2.pdf
Plasticiser	FEBMIX DH MORTAR PLASTICISER	Sika	https://www.sealantsandtoolsdirect.co.uk/pub/pdfs/Feb_Febmix_DH_Mortar_Plasticiser_rev3_safety_Datasheet.pdf
Plasticiser	Prestige Concreting Additives P/L Plasticiser	Prestige	https://www.sunrisemarketing.net.au/wp-content/uploads/2020/03/Addcrete-Safety-Data-Sheet-Plasticiser.pdf
Plasticiser	MORTAR PLASTICISER – ADMIX	Palace Chemicals Ltd	https://palacechemicals.co.uk/wp-content/uploads/2012/10/coshh-msds-CLP-GHS-051-ADMIX-MORTAR-PLASTICISER-05-2016.pdf
Plasticiser	W-42SL Superplasticizer Admixture	Specco Industries Ltd	https://specco.com/SDS-PDF/Admixtures/W-42SL_Superplasticizer_SDS_12-01-15.pdf
Plasticiser	Wickes No Crack Concrete	Sika	https://s7g10.scene7.com/is/content/wickes/Cement-Additives-Sealants-Sika-Cim-No-Crack-Concrete-Admixture-75g~S3451_154064_COSHH_0
Plasticiser	Superplasticizer	Multiurethanes Ltd.	https://multiurethanes.com/wp-content/uploads/2018/07/Multiurethanes-SDS-Superplasticizer.pdf
Plasticiser	Daracem 100	Grace Canada	https://ehslegacy.unr.edu/msdsfiles/21345.pdf
Plasticiser	Brickies Own	Cement Australia Pty Limited	https://www.cementaustralia.com.au/sites/default/files/2018-07/CASDS68%2BBrickie%27s%2BOwn.pdf
Hardener	403 CONCRETE HARDENER AND DUSTPROOFER	Sika	https://www.sealantsandtoolsdirect.co.uk/pub/pdfs/everbuild-403-concrete-hardener-safety-data-sheet.pdf
Hardener	Sika®-3 Rapid Hardener	Sika	https://gbr.sika.com/dms/getdocument.get/45c3609c-b0a7-3790-a93e-cc47c45140bc/Sika3.pdf
Hardener	LIQUI-HARD	W. R. MEADOWS, INC	https://www.wrmeadows.com/MSDS-PDF/3325000-6.pdf
Hardener	Concrete Hardener & Sealer	Genlabs	https://genlabscorp.com/ghssds/08888_EN.pdf
Hardener	DRIBOND CONCRETE HARDENER	DRIBOND CONSTRUCTION CHEMICALS	https://constructionchemicals.com.au/wp-content/uploads/2018/06/SDS-concrete-hardener-feb21.pdf

Type of Additive	**Product**	**Company**	**SDS Link**
Hardener	SILICATE FLOOR HARDENER	Parex	http://www.parex.co.uk/GetFile.ashx?file_id=389
Hardener	L&M FGS Hardener	Laticrete	https://www.anchsand.com/wp-content/uploads/2018/08/fgs-hardener-plus-sds.pdf
Colour Hardener	SureCast Color Hardener	SureCrete	https://surecretedesign.com/sds/colors-stains-color-hardener-sds.pdf
Hardener	2k Hardener/ Concrete Floor Armor Hardener	Por Products	https://sds.por15.com/Concrete%20Floor%20Armor/POR-15-Part-B-Concrete-Floor-Armor-Hardener-43211B-43214B-47311B-47314B-SDS.pdf
Hardener	GREEN CONCRETE CURE & HARDENER	Oxtek	https://www.oxtek.com.au/images/MSDS_X100_Green_Concrete_Cure__Hardener.pdf
Hardener	Cemix Concrete Hardener	Cemix	https://www.cemix.co.nz/wp-content/uploads/2018/11/Concrete-Hardener.pdf
Colour Hardener	Color Hardener	Dynamic Colour Solutions	https://static1.squarespace.com/static/5f5f88ef9bb44b2323cac156/t/5f8ef9339009bd6755403bc9/1603205431673/DCS+Color+Hardener+SDS.pdf
Sealer	Beton Hardener Lithium	Klindex	http://www.klindexsupport.it/msds/Beton_Hardener_Lithium_ENG_MSDS.pdf
Hardener	Quartz Floor Hardener	SpecChem	http://www.construventas.net/pdfs/endu_densi/Quartz-Floor-Hardener-SDS.pdf
Epoxy	DEVCON® Epoxy Concrete Sealer Resin	ITW Performance Polymers	https://itwperformancepolymers.com/wp-content/uploads/umb/15247/12560-devcon-epoxy-concrete-sealer-2-gal.pdf
Epoxy	EPAR EX Epoxy Hardener	Stratmore Construction Solutions Ltd	https://assets.website-files.com/5cecb5b65d0f477c58a4e335/5d195185f3be3c641a8e40c0_EPAR-EX-Hardener-MSDS-2019.pdf
Colour Hardener	Dura Color Hardener	Duracorp	https://cdn.concretestamps.xyz/sds/DURA%20COLOR%20HARDENER%20SDS.pdf
Sealer	PS103 Lithium Silicate Densifier WB Penetrating Sealer	Concrete Sealers USA	https://www.concretesealersusa.com/content/pdfs/PS103SafetyDataSheet.pdf
Epoxy	Advanced Epoxy Floor Paint Base	Magic Bullet	http://www.magicbulletproducts.com/media/catalog/product/pdf/AEFP_Advanced_Epoxy_Floor_Paint_MSDS_1.pdf
Epoxy	RonaFloor Epoxy Floor Mortar Unpigmented Resin	Ronacrete	https://ronacrete.co.uk/demo/wp-content/uploads/2016/09/RonaFloor-Epoxy-Floor-Mortar-SDS.pdf
Epoxy	PC CONCRETE EPOXY, PART A	PC	https://www.pcepoxy.com/wp-content/uploads/2019/07/SDS-Concrete-Canada-Eng-2018.pdf
Epoxy	Various	Armour Proxy	https://armorpoxy.com/resources/sds-and-msds/
Epoxy	Pioneer Plus Five Epoxy	Pioneer	http://tannamdo.com/uploads/msds/msds---plus-five-epoxy.pdf
Epoxy	Red Head® C6+, Part A	Red Head	https://www.itwredhead.com/portals/0/documents/sell-sheets/C6-Resin.pdf
Epoxy	EPCON C6+ part B	Red Head	https://www.simpsonandbrown.com/wp-content/uploads/2018/01/Epcon-C6-Part-A-Resin-ITW-Red-Head-.pdf

A P P E N D I X

A

Conceptual Site Model Sensitivity Analysis

Input Parameters and Results

End of Waste - Sensitivity Analysis Input Parameters

Groundwater Recharge (mm/yr)

Value	Source
300	Waste Acceptance Criteria for a high permeability scenario
30	Waste Acceptance Criteria for hardstanding scenario. Infiltration assumed to be 10%. HS assumed to be analagous to a lower permeability soil scenario in GSI GW recharge map report
1000	GSI GW recharge map, high level value in exposed highland karstic areas, with limited well draining soil above aquifer
1500	GSI GW recharge map, max value from exposed Karstic areas
500	GSI GW recharge map, approx 90th percentile value
100	Highland Karstic areas with hardstanding present or low permeability subsoil
50	Other areas where hardstanding present or low permeability subsoil

Effective of climate change on recharge estimate (fraction increase over next 100 years, 2022 to 2222)

Value	Source
0.2	A 5% increase in average annual rainfall was observed between 1981 and 2010, https://www.epa.ie/environment-and-you/climate-change/what-impact-will-climate-change-have-for-ireland/. Assumed that a 5% increase takes place every 25 years
0.1	Low end estimate - stabilisation around 2072
0.3	High end estimate - increasing change

Hydraulic Conductivity (m/d)

Value	Source
0.011	GSI 2015 Irish Aquifer properties - low end value for poor aquifer, generally only productive in localised zone
0.15	GSI 2015 Irish Aquifer properties - value for poor aquifer, generally unproductive
0.113	GSI 2015 Irish Aquifer properties - value for locally important lst aquifer, moderatively productive in local zones
0.5	GSI 2015 Irish Aquifer properties - high end value for limestone locally important aquifers, low end value for regional lst aquifers
1.148	GSI 2015 Irish Aquifer properties - high end value for regional limestone karstic aquifers
5	Papers from Ryan (2020) and Needham *et.al* . (2020) in IAH proceedings 2020. High end local value for Calp LST
8	GSI 2015 Irish Aquifer properties - Sand and gravel 5th percentile value
39	GSI 2015 Irish Aquifer properties - Sand and gravel best estimate
395	GSI 2015 Irish Aquifer properties - Sand and gravel 95th percentile value
12	Waste Acceptance Criteria Value

Hydraulic Gradient (-/-)

Value	Source
0.001	Low range value for lowland aquifers. D Drew. Hydrogeology of lowland karst in ireland, QJEH, Feb 2008.
0.01	High range value for lowland aquifers. D Drew. Hydrogeology of lowland karst in ireland, QJEH, Feb 2008.
0.01	Approximate value for highland Karst. D Drew. Hydrogeology of lowland karst in ireland, QJEH, Feb 2008.
0.01	Estimated approximate value for low hydraulic conductivity poor aquifers
0.003	Estimated mid range value for regional/ locally important aquifers

Aquifer thickness (m)

Value	Source
6	Waste Acceptance Criteria Value
10	High range Epikarst value in LST, excluding near the sea - GSI Powerpoint, Plunkett and Dillon 1985
1	Low range epikarst value -- GSI Powerpoint, Plunkett and Dillon 1985
5	Mid range Epikarst value. Assumed value for fracture low productivity aquifers
10	No epikarst, straight onto lower permeability Lst

Sources

Drew, D.P., 2008. Hydrogeology of lowland karst in Ireland. Quarterly Journal of Engineering Geology and Hydrogeology, 41, 61-72

Geological Survey of Ireland 2015. Irish Aquifer Properties - A Reference Manual and Guide, V1 March 2015

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Needham, S.N., Ford, M., Wealthall, G., Webb, G., Morgan, A., O'Loughlin, S. and Haworth, H. (Geosyntec Consultants), 2020. Characterisation and Evolution of a TCE Plume in Fractured Limestone. In Proceedings of the 40th Annual Conference of the International Association of Hydrogeologists (Irish Group): Characterisation and Management of Groundwater in Limestones

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Ryan, M, (Bryne Looby) 2020. Basement Construction in Dublin and Interaction witht the Underlying Calp Limestone. In Proceedings of the 40th Annual Conference of the International Association of Hydrogeologists (Irish Group): Characterisation and Management of Groundwater in

Williams, N.H., Misstear, B., Daly, D., Johnston, P., Lee, M., Cooney, P. and Hickey, C, 2011. A National Groundwater Recharge Map for Ireland, National Hydrology Conference 2011

Williams, T.H. and Lee, M. Characterisation of the groundwater environment for resource assessment, development, management and protection. Groundwater Section Geological Survey of Ireland

End of Waste - Sensitivity Analysis Results

Scenario A, 100m x 100m source, Open ground

Scenario	Scenario Description	GW recharge (mm/yr)	100yr CC increase on recharge (-/-)	K (m/d)	i (-/-)	B (m)	Level 2 Dilution Factor
A	WAC scenario, steady increase in rainfall due to climate change	300	0.2	12	0.001	6	1.73
B	Exposed highland karstic aquifer, high recharge, high permeability	1000	0.2	1.148	0.01	5	1.02
C	Regional/local Karstic aquifer, av values not in exposed area	500	0.2	0.5	0.003	5	1.05
D	Highly permeable regional Karstic aquifer, not in exposed area	500	0.2	1.148	0.001	5	1.03
E	Low permeability Lst aquifer, no epikarst, not in exposed area	500	0.2	0.113	0.01	10	1.07
F	Regional/local Karstic aquifer, not in exposed area, thin epikarst	500	0.2	0.5	0.003	1	1.01
G	Local high K Karstic aquifer	500	0.2	5	0.001	10	1.30
H	Scenario C, with lower effect of CC	500	0.1	0.5	0.003	5	1.05
I	Scenario C, with higher effect of CC	500	0.3	0.5	0.003	5	1.04
J	Sand and gravel aquifer - medium permeability	500	0.2	39	0.001	5	2.19
K	Sand and gravel aquifer - low permeability, thin	500	0.2	8	0.001	1	1.05
L	Sand and gravel aquifer - high permeability, thick	500	0.2	395	0.001	10	25.03
M	Scenario J, with lower effect of CC	500	0.1	39	0.003	5	2.29
N	Scenario J, with higher effect of CC	500	0.3	39	0.003	5	2.10
O	Locally productive, poor aquifer, GW flow in fractured zone at top	500	0.2	0.011	0.01	5	1.00
P	Higher permeability poor aquifer, GW flow in fractured zone at top	500	0.2	0.15	0.01	5	1.05
Q	Scenario O, with lower effect of CC	500	0.1	0.011	0.01	5	1.00
R	Scenario O, with higher effect of CC	500	0.3	0.011	0.01	5	1.00

Estimates do not take into account background concentratons

Averages

	Mean	Geomean
Lst Aquifer	1.07	1.07
S&G Aquifer	6.53	3.08
Poor Aquifer	1.01	1.01
All	2.61	1.46

Scenario B, 100m x 100m source, Hardstanding or Low Permeability subsoi

Scenario	Scenario Description	GW recharge (mm/yr)	100yr CC increase on recharge (-/-)	K (m/d)	i (-/-)	B (m)	Level 2 Dilution Factor
A	WAC scenario, steady increase in rainfall due to climate change	30	0.2	12	0.001	6	8.3
B	Exposed highland karstic aquifer, high recharge, high permeability	100	0.2	1.148	0.01	5	2.75
C	Regional/local Karstic aquifer, av values not in exposed area	50	0.2	0.5	0.003	5	1.46
D	Highly permeable regional Karstic aquifer, not in exposed area	50	0.2	1.148	0.001	5	1.35
E	Low permeability Lst aquifer, no epikarst, not in exposed area	50	0.2	0.113	0.01	10	1.59
F	Regional/ local Karstic aquifer, not in exposed area, thin epikarst	50	0.2	0.5	0.003	1	1.09
G	Local high K Karstic aquifer	50	0.2	5	0.001	10	4.04
H	Scenario C, with lower effect of CC	50	0.1	0.5	0.003	5	1.5
I	Scenario C, with higher effect of CC	50	0.3	0.5	0.003	5	1.42
J	Sand and gravel aquifer - medium permeability	50	0.2	39	0.001	5	12.86
K	Sand and gravel aquifer - low permeability, thin	50	0.2	8	0.001	1	1.49
L	Sand and gravel aquifer - high permeability, thick	50	0.2	395	0.001	10	241.29
M	Scenario J, with lower effect of CC	50	0.1	39	0.003	5	13.94
N	Scenario J, with higher effect of CC	50	0.3	39	0.003	5	11.95
O	Locally productive, poor aquifer, GW flow in fractured zone at top	50	0.2	0.011	0.01	5	1.03
P	Higher permeability poor aquifer, GW flow in fractured zone at top	50	0.2	0.15	0.01	5	1.46
Q	Scenario O, with lower effect of CC	50	0.1	0.011	0.01	5	1.04
R	Scenario O, with higher effect of CC	50	0.3	0.011	0.01	5	1.03

Estimates do not take into account background concentratons

Averages

	Mean	Geomean
Lst Aquifer	1.90	1.73
S&G Aquifer	56.31	15.04
Poor Aquifer	1.14	1.13
All	17.20	3.13

A P P E N D I X

B

Recommended Inert Wastes Acceptable for the Production of Recycled Aggregate

Recommended Inert Wastes Acceptable for the Production of Recycled Aggregate

Waste from physical and chemical processing of non-metalliferous minerals

Type and Restrictions	Waste Code
Waste gravel and crushed rock other than those mentioned in 01 05 07	**01 04 08**
Waste sand and clays Waste sand only - not to include contaminated sand, unless sand to be cleaned up to a proven acceptable standard during recovery.	**01 04 09**

Construction and demolition waste - concrete, bricks, tiles and ceramics

Type and Restrictions	Waste Code
Concrete No concrete including epoxy resin coatings.	**17 01 01**
Bricks	**17 01 02**
Tiles and Ceramics	**17 01 03**
Mixtures of concrete, bricks, tiles and ceramics other those mentioned in 17 01 06	**17 01 07**

Construction and demolition waste - soil

Type and Restrictions	Waste Code
Soil and Stones other than those mentioned in 17 05 03 Soil to be sand and gravel materials only Not to include contaminated soil or stone, unless material is cleaned up to a proven acceptable standard during recovery.	**17 05 04**
Dredging Spoil other than those mentioned in 17 05 06 To be sand and gravel materials only. Not to include contaminated material, unless cleaned up to a proven acceptable standard during recovery.	**17 05 06**
Track Ballast other than those mentioned in 17 05 07 To be sand and gravel materials only. Not to include contaminated material, unless cleaned up to a proven acceptable standard during recovery.	**17 05 08**

Wastes from the mechanical treatment of waste not otherwise specified

Type and Restrictions	Waste Code
Minerals (for example sand, stones) To be sand and gravel materials only. Not to include contaminated material , unless cleaned up to a proven acceptable standard during recovery.	**19 12 09**

Wastes from soil and groundwater remediation

Type and Restrictions	Waste Code
Solid wastes from soil remediation other than those mentioned in 19 13 01 To be sand and gravel materials only. Material must be cleaned up to a proven acceptable standard during recovery.	**19 13 02**

Municipal Wastes - including separately collected fractions

Type and Restrictions	Waste Code
Garden and park wastes (including cemetery waste) - soil and stones To be sand and gravel materials only. Not to include contaminated material, unless cleaned up to a proven acceptable standard during recovery.	**20 02 02**

A P P E N D I X

C

Input Values and Calculation Outputs for Derivation of Pollutant Limit Values

Table C1: Contaminant of Concern Input Parameters

Contaminant	WQS protective of GW (µg/l)	WQS Source	Surface Water GAC (µg/l) FW	WQS Source	Chosen WQS value (µg/l)	Ireland Background Levels (µg/l), Confined Strata (Source EPA RR 183)			Applied WQS (µg/l) Chosen WQS - Background, except DOC/TOC where Applued WQS = background	Kappa (kg/l) (Source Hjelamr 2004, except *JRC 2014)	KOC (L/Kg) (Source EA SR7, except **)	Henrys Law Constant (Dimensionless) (Source EA SR7, except **)
						5th %ile	Median	95th percentile				
As	7.5	EU GW regulations 2016	25	SW Reg 2019	7.5	0.1	0.25	2	7.25	0.03	Not Applicable	Not Applicable
Ba	700	WHO 2017 DWG	-	-	700	2.7	29.3	224	670.7	0.15	Not Applicable	Not Applicable
Cd	3.75	EU GW regulations 2010	0.08	SW Reg 2019	3.75	0.05	0.05	0.2	3.7	0.5	Not Applicable	Not Applicable
Cr Total	37.5	EU GW regulations 2016	4.7 (Cr III)	SW Reg 2019	37.5	0.25	0.25	0.53	37.25	0.18	Not Applicable	Not Applicable
Cu	1,500	EU GW regulations 2010	5	SW Reg 2019	1,500	0.25	1.5	16	1,498.5	0.28	Not Applicable	Not Applicable
Hg	0.75	EU GW regulations 2016	0.05	SW Reg 2019	0.75	0.01	0.025	0.025	0.725	0.1	Not Applicable	Not Applicable
Mo	70	WHO 2017 DWG	-	-	70	0.25	0.5	0.63	69.5	0.35	Not Applicable	Not Applicable
Ni	15	EU GW regulations 2010	20	SW Reg 2019	15	0.25	0.5	2.15	14.5	0.29	Not Applicable	Not Applicable
Pb	7.5	EU GW regulations 2016	7.2	SW Reg 2019	7.5	0.15	0.25	2.81	7.25	0.27	Not Applicable	Not Applicable
Sb	5	EU DW 2014	-	-	5	0.05	0.25	0.5	4.75	0.11	Not Applicable	Not Applicable
Se	10	EU DW 2014	-	-	10	-	-	-	10	0.38	Not Applicable	Not Applicable
Zn	75	EU GW regulations 2016	8	SW Reg 2019	75	1.6	6.9	40	68.1	0.28	Not Applicable	Not Applicable
V	86	US RSL	17.8	ECHA PNEC	17.8	-	-	-	17.8	0.04*	Not Applicable	Not Applicable
Chloride	187,500	EU GW regulations 2016	250,000	SW Reg 2019	187,500	8,000	14,300	21,000	173,200	0.57	Not Applicable	Not Applicable
Flouride	800	EU GW regulations 2016	500	SW Reg 2019	800	50	80	200	720	0.22	Not Applicable	Not Applicable
Sulphate	250,000	EU GW regulations 2016	250,000	SW Reg 2019	250,000	500	5,800	13,160	244,200	0.33	Not Applicable	Not Applicable
Phenol			8	SW Reg 2019	8	-	-	-	8	0.3	Not Applicable	Not Applicable
DOC / TOC	No Abnormal Change	EU DW 2014	-	-	-	440	1800	26300	26,300	0.17	Not Applicable	Not Applicable
TDS	None Identified				-	-	-	-	-	-	-	-
pH	OK between 6.5 and 9.5	EW DW 2014	Ok between 6 and 9	SW Reg 2019	Ok between 6.5 and 9	5.2	7.2	7.86	Ok between 6.5 and 9	-	-	-
Benzene	0.75	EU GW regulations 2016	10	SW Reg 2019	0.75	-	-	-	0.75	Not Applicable	68	0.116
Toluene	525	EU GW regulations 2016	10	SW Reg 2019	525	-	-	-	525	Not Applicable	204	0.115
Ethylbenzene	10	IGV 2003	100	ECHA PNEC					10	Not Applicable	447	0.139
Xylenes	-	-	10	SW Reg 2019	10	-	-	-	10	Not Applicable	427	0.092
PCBs: PCB28	0.01	IGV 2003	-	-	0.01	-	-	-	0.01	Not Applicable	40,738**	0**
Mineral Oil: TPH C10-C12	7.5	EU GW regulations 2016	-	-	7.5	-	-	-	7.5	Not Applicable	239883**	64.4**
Mineral Oil: TPH C12-C16	7.5	EU GW regulations 2016	-	-	7.5	-	-	-	7.5	Not Applicable	5370318**	171**
Mineral Oil: TPH C16-C35	7.5	EU GW regulations 2016	-	-	7.5	-	-	-	7.5	Not Applicable	575439937**	1070**
Mineral Oil: TPH C35-44	7.5	EU GW regulations 2016	-	-	7.5	-	-	-	7.5	Not Applicable	575439937**	1070**
PAH: Benzo(a)pyrene	0.0075	EU GW regulations 2016	1.70E-04	SW Reg 2019	0.01	-	-	-	0.0075	Not Applicable	646	0.00662
PAH: Naphthalene	0.0125	EU GW regulations 2016	2	UK EQS 2015	1	-	-	-	0.0125	Not Applicable	18197	0.0000629
PAH: Fluoranthene	1	IGV 2003	0.0063	UK EQS 2015	1	-	-	-	1	Not Applicable	128825	0.00000176

Notes

Naphthalene GW WQS taken as one sixth of the PAH Sum of 6 GW WQS. PAH sum of 6 comprises anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene and naphthalene. Naphthalene taken as indicator compound of all these PAHs as it is the most mobile of these compounds (i.e. has the lowest Koc value).

Kappa values only applicable for contaminants for which 10 L/Kg Leachate PLVs have been generated.

KOC (Organic Carbon Partitioning Coefficient) and Henrys Law Constant only applicable for contaminants for which Total Concentrations PLVs have been generated.

Sources

EU GW regulations 2016	SI No. 366 of 2016, European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016
EU GW regulations 2010	SI No. 9 of 2010, European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2010
EW DW 2014	SI No. 122 of 2014, European Union (Drinking Water) (Amendment) Regulations 2014
SW Reg 2019	SI 77 of 2019, European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019
WHO 2017	2017 World Health Organisation, Guidelines for Drinking Water Quality (4th Edition) (guidelines and health-based values)
GWQC EU LFD	Groundwater quality criteria used in the setting of Danish WAC for landfilling as part of implementing Directive 1999/31/EC and Council Decision 2003/33/EC. Within Hjelmar 2016
IGV 2003	2003 EPA Interim Guideline Values
UK EQS 2015	The Water Framework Directive (Standards and Classification)Directions (England and Wales) 2015, Freshwater Environmental Quality Standards
US RSL	United State Environmental Protection Agency Regional Screening Level, maximum concentration level for tapwater protective of human health for target risk of 1 in 1,000,000 and target hazard quotient of 1.0, values as of May 2022, https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
ECHA PNEC	Point of No Expected Concern level derived by the European Chemicals Agency, Values as of June 2022, https://echa.europa.eu
Hjelmar 2004	Hjelmar, O., Holm, J., Hansen, J. G. and Dahlstrom, K 2004. The European criteria for acceptance of waste at landfills: Implementation of Council Decision 2003/33/EC in Denmark
Hjelmar 2016	Hjelmar, O., Hansen, J. B., Wahlstrom, M. and Wik, O. 2016. End-of-Waste Criteria for Construction & Demolition Waste, Ref. TemaNord 2016:524
JRC 2014	Joint Research Centre of the European Comission, 2014, Technical Report, Study on methodological aspects regarding limit values for pollutants in aggregates in the context of the possible development of end-of-waste criteria under the EU Waste Framework Directive, Ref. EUR 26769 EN
EPA RR 183	EPA 2017, Research Report No. 183, Assessing and Developing Natural Background Levels for Chemical Parameters in Irish GW
EA SR7	Environment Agency, 2007 Science Report SC050021/SR7 Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values
**	TPH fraction KOC and Henrys' constant values taken from appropriate aliphatic fractions from Land Quality Management/ The Chartered Institute of Environmental Health, 2014. The LQM/ CIEH S4ULs for Human Health Risk Assessment
**	For PCB28 Koc is value from Waid (Editor) 1986, PCBs and The Environment. Henry's Law Constant is conservatively assumed to be 0/

Table C2: Calculation of Leachate Targets for Scenario A

Contaminant	Haz/ Non Haz	Effective WQC (ug/l)	Kappa (kg/l)	Pore Water Target (mg/l)	0.2:1 L/S Ratio Leachate Target (mg/kg)	2:1 L/S Ratio Leachate Target (mg/kg)	10:1 L/S Ratio Leachate Target (mg/kg)	UKAS Accredited Laboratory Detection Limit, 10:1 L/S Ratio leachate (mg/kg)	Proposed PLV-A (mg/kg)
As	Haz	7.25	0.03	0.00725	0.00145	0.01407	0.06264	0.025	0.063
Ba	Non Haz	670.7	0.15	0.979222	0.19294	1.69198	5.07152	0.03	5.1
Cd	Haz	3.7	0.5	0.0037	0.00070	0.00468	0.00735	0.005	0.0074
Cr Total	Non Haz	37.25	0.18	0.054385	0.01068	0.09134	0.25220	0.015	0.25
Cu	Non Haz	1498.5	0.28	2.18781	0.42554	3.35040	7.33846	0.07	7.3
Hg	Haz	0.725	0.05	0.000725	0.00014	0.00138	0.00571	0.0001	0.0057
Mo	Non Haz	69.5	0.35	0.10147	0.01960	0.14595	0.28116	0.02	0.28
Ni	Non Haz	14.5	0.29	0.02117	0.00411	0.03213	0.06898	0.02	0.069
Pb	Not listed	7.25	0.27	0.010585	0.00206	0.01636	0.03657	0.05	<0.05
Sb	Non Haz	19.75	0.11	0.028835	0.00570	0.05177	0.17488	0.02	0.17
Se	Not listed	40	0.38	0.0584	0.01125	0.08181	0.15025	0.03	0.15
Zn	Non Haz	68.1	0.28	0.099426	0.01934	0.15226	0.33350	0.03	0.33
V	Non Haz	86	0.04	0.12556	0.02501	0.24134	1.03487	0.006	1
Chloride	Not listed	173200	0.57	252.872	47.79815	301.75215	442.15070	3	440
Flouride	Non Haz	720	0.22	1.0512	0.20568	1.70086	4.24874	3	4.2
Sulphate	Undetermined	244200	0.33	356.532	69.00421	521.99382	1040.55143	5	1000
Phenol	Non Haz	8	0.3	0.01168	0.00227	0.01757	0.03699	0.1	<0.1
DOC	Not listed	26300	0.17	38.398	7.55051	65.10261	184.60775	20	180

Note

See Table C1 for sources of input parameters

See Section 2.2 of main text for detailed discussion on derivation of PLVs.

Table C3: Calculation of Leachate Targets for Scenario B

Contaminant	Haz/ Non Haz	Effective WQC (ug/l)	Kappa (kg/l)	Pore Water Target (mg/l)	0.2:1 L/S Ratio Leachate Target (mg/kg)	2:1 L/S Ratio Leachate Target (mg/kg)	10:1 L/S Ratio Leachate Target (mg/kg)	UKAS Accredited Laboratory Detection Limit, 10:1 L/S Ratio leachate (mg/kg)	Proposed PLV-B (mg/kg)
As	Haz	7.25	0.03	0.00725	0.00145	0.01407	0.06264	0.025	0.063
Ba	Non Haz	670.7	0.15	2.099291	0.41362	3.62732	10.87251	0.03	11
Cd	Haz	3.7	0.5	0.0037	0.00070	0.00468	0.00735	0.005	0.0074
Cr Total	Non Haz	37.25	0.18	0.1165925	0.02290	0.19583	0.54067	0.015	0.54
Cu	Non Haz	1498.5	0.28	4.690305	0.91228	7.18272	15.73245	0.07	16
Hg	Haz	0.725	0.05	0.000725	0.00014	0.00138	0.00571	0.0001	0.0057
Mo	Non Haz	69.5	0.35	0.217535	0.04202	0.31289	0.60276	0.02	0.6
Ni	Non Haz	14.5	0.29	0.045385	0.00882	0.06888	0.14789	0.02	0.15
Pb	Not listed	7.25	0.27	0.0226925	0.00442	0.03507	0.07840	0.05	0.078
Sb	Non Haz	19.75	0.11	0.0618175	0.01223	0.11098	0.37491	0.02	0.37
Se	Not listed	40	0.38	0.1252	0.02411	0.17539	0.32210	0.03	0.32
Zn	Non Haz	68.1	0.28	0.213153	0.04146	0.32642	0.71497	0.03	0.71
V	Non Haz	86	0.04	0.26918	0.05362	0.51739	2.21858	0.006	2.2
Chloride	Not listed	173200	0.57	542.116	102.47138	646.90700	947.89842	3	950
Flouride	Non Haz	720	0.22	2.2536	0.44095	3.64636	9.10861	3	9.1
Sulphate	Undetermined	244200	0.33	764.346	147.93369	1119.06894	2230.77121	5	2,200
Phenol	Non Haz	8	0.3	0.02504	0.00486	0.03766	0.07931	0.1	<0.1
DOC	Not listed	26300	0.17	82.319	16.18706	139.56929	395.76868	20	400

Note

See Table C1 for sources of input parameters

See Section 2.2 of main text for detailed discussion on derivation of PLVs.

Table C4: Solid PLV Calculation - Soil Parameters

Parameter	Value	Unit	Source/ Justification
Water filled soil porosity	0.24	fraction	Value for a sand - UK Environment Agency, 2009, Updated technical background to the CLEA model (SR3)
Air filled soil porosity	0.3	fraction	
Bulk density of soil zone material	1.18	g/cm3	
Fraction of organic carbon (in soil) (foc)	0.001	fraction	Product will be aggregate with limited fines. Unlikely to be significant amounts of organic carbon and low value assumed

Table C5: Solid PLV Calculation - Individual Compounds Total Concentration Target Calculations

Compound	KOC (L/Kg)	Henrys Law (dimensionless)	Pore Water Target (mg/l)	Total Concentration Target (mg/kg)
Phenol (PLV A)	83.17637711	0.00000835	0.01168	0.003347118
Phenol (PLV B)	83.17637711	0.00000835	0.02504	0.007175671
Benzene	67.60829754	0.116	0.00075	0.000225367
Ethylbenzene	446.6835922	0.139	0.01	0.006854124
Toluene	204.1737945	0.115	0.525	0.229320479
Xylenes	426.5795188	0.092	0.01	0.006533592
PCBs: PCB28	40,738	0	0.00001	0.000409414
Mineral Oil: TPH C10-C12	239883.2919	64.4	0.0075	1.923446723
Mineral Oil: TPH C10-C16	5370317.964	171	0.0075	40.60496947
Mineral Oil: TPH C16-C35	575439937.3	1070	0.0075	4317.84131
Mineral Oil: TPH C35-44	575439937.3	1070	0.0075	4317.84131
PAH: Naphthalene	645.654229	0.00662	0.001	0.000850727
PAH: Fluoranthene	18197.00859	0.0000629	0.001	0.018400414
PAH: Benzo(a)pyrene	128824.9552	0.00000176	0.0000075	0.000967713
PAH: Sum of 4	109647.8196	0.00000174	0.000075	0.008238841

Note

See Table C1 for sources of input parameters

See Section 2.2 of main text for detailed discussion on derivation of PLVs.

Individual Compound	Total Concentration Target (mg/kg)	Compound Group	Group Total Concentration Target (mg/kg)
Benzene	0.0002	Total BTEX	0.0002
Toluene	0.2293		
Ethylbenzene	0.0069		
Xylenes	0.0065		
PCBs: PCB28	0.00041	PCBS (7 Congeners)	0.00041
TPH C10-C12	1.92	Mineral Oil C10-C40	1.92
TPH C12-C16	40.60		
TPH C16-C35	4317.84		
TPH C35-44	4317.84		
PAH: Naphthalene	0.0009	Total PAH (17 including Coronene)	0.0009
PAH: Fluoranthene	0.0184		
PAH: Benzo(a)pyrene	0.0010		

Note

See Section 2.2 of main text for detailed discussion on derivation of PLVs.

Compound Group	Group Total Concentration Target (mg/kg)	Typical Laboratory Limit of Detection for Total Compound Group Concentrations (mg/kg)	Proposed Solid PLV (mg/kg)
Total BTEX	0.0002	0.025	0.025
PCBs (7 congeners)	0.000409414	0.035	0.035
Mineral Oil C10-C40	1.92	30	50
Total PAH (17 including Coronene)	0.0009	0.64	2

Note

See Section 2.2 of main text for detailed discussion on derivation of PLVs.

A P P E N D I X

D

Industry Dataset Summary Statistics and Data Distribution Plots vs Pollutant Limit Values

Table D1: Concrete (Unwashed, Ground, Waste) Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	32	13	0.0048	*0.01*	*0.01*	0.026675	0.04417	0.06	0.0186	0.0149
Arsenic	75	20	0.0002	0.005	0.006	0.05	0.05408	0.0744	0.0245	0.00981
Barium	75	71	0.029	0.493	1.37	2.55	9.513	10.3	2.13	0.927
Cadium	75	3	*0.00011*	*0.0008*	*0.0008*	*0.01*	*0.01*	0.39	0.0104	0.00172
Chloride	75	56	*10*	26.5	47	71	146	400	63.7	46.4
Chromium	75	57	*0.005*	0.0587	0.13	0.1975	0.253	0.63	0.132	0.0838
Copper	75	68	0.00348	0.02645	0.063	0.079	0.136	0.47	0.0662	0.0493
DOC	32	18	*30*	*30*	43.25	71.675	90.895	99.5	50.8	45.9
Fluoride	32	2	*5*	*5*	*5*	*5*	5.252	15.9	5.36	5.2
Lead	75	20	*0.0005*	*0.002*	*0.005*	*0.01*	0.01803	0.28	0.0111	0.00473
Mercury	75	1	*0.00005*	*0.0001*	*0.0001*	*0.005*	*0.005*	0.005	0.0019	0.000447
Molybdenum	75	57	*0.03*	*0.05*	0.069	0.082	0.138	0.23	0.0702	0.0625
Nickel	75	38	0.004	0.00762	0.026	0.05	0.0518	0.49	0.0371	0.0203
Phenol	32	1	*0.12*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	-	-
Selenium	75	5	*0.005*	*0.01*	*0.01*	*0.01*	0.0152	0.4	0.0172	0.0109
Solids Total Dissolved	32	32	517	1470	12750	32350	57090	60500	19500	7310
Sulphate	75	62	*10*	50	120	202.5	1064	2800	282	124
Zinc	75	26	0.0025	0.01235	0.025	0.5	0.5	0.7742	0.215	0.0645
pH (pH Units)	30	30	1	10.1525	11.84	12.3175	12.543	12.58	11.2	11.1
Aluminium	31	24	0.197	0.9015	2.37	8.77	22.2	24.9	5.85	2.63
Berylium	31	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.006	0.00116	0.00106
Boron	31	14	*0.1*	*0.1*	*0.1*	0.3505	0.536	0.6	0.21	0.161
Cobalt	31	4	*0.005*	*0.005*	*0.005*	*0.005*	0.005355	0.03	0.00583	0.00532
Lithium	31	31	0.0359	0.1015	0.299	0.618	0.9355	0.996	0.374	0.231
Manganese	31	1	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	0.18	0.0348	0.0318
Phosphorus	31	11	0.1	0.1	0.1	0.1125	0.1915	0.6	0.128	0.116
Strontium	31	31	0.457	1.095	7.6	21.05	34.1	35	11.6	4.76
Thallium	31	1	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	0.12	0.0232	0.0212
Titanium	31	22	*0.01*	*0.01*	0.0147	0.02005	0.0314	0.06	0.0176	0.0156
Vanadium	31	21	*0.01*	*0.01*	0.0419	0.2075	0.2985	0.352	0.101	0.0453
Silver	31	2	0.005	0.005	0.005	0.005	0.00508	0.03	0.00581	0.0053
Sodium	31	31	15.8	35.3	94.6	178.5	281.5	287	113	74.5
Magnesium	31	21	*0.36*	*0.36*	4.04	6.23	12.7	14.2	4.78	2.48
Potassium	31	31	16.7	47.55	198	397.5	621.5	643	233	122
Calcium	31	31	112	278	1690	4040	5955	6340	2250	1070
Iron	31	14	*0.19*	*0.19*	*0.19*	2.185	3.55	4.18	1.28	0.605
Chromium VI	31	2	*0.3*	*0.3*	*0.3*	*0.3*	0.3325	0.397	0.305	0.305

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D2: Concrete (Not Ground, Waste) Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	46	6	*0.02*	*0.02*	*0.02*	*0.02*	0.05	0.07	0.0241	0.0225
Arsenic	46	1	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	0.033	0.0252	0.0252
Barium	46	37	*0.03*	0.0725	0.185	0.8225	1.7125	2.8	0.525	0.215
Cadium	14	0	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	-	-
Chloride	14	14	4	10.5	14.5	38.5	72.25	108	26.6	17.3
Chromium	46	40	*0.015*	0.05375	0.115	0.273	0.5065	0.617	0.169	0.105
Copper	14	0	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	-	-
DOC	14	11	*20*	23.5	29	77.75	106.6	117	48.1	38.6
Fluoride	14	1	*3*	*3*	*3*	*3*	4.05	6	3.21	3.15
Lead	14	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Molybdenum	46	19	*0.02*	*0.02*	*0.02*	0.04	0.07	0.11	0.0335	0.029
Nickel	14	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Phenol	14	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Selenium	46	0	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	-	-
Solids Total Dissolved	14	14	619	1208.25	2341	3340.5	8017.3	8133	2930	2220
Sulphate	46	46	18	54.5	158	286.375	1203.875	4454	386	152
Zinc	14	0	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	-	-
pH (pH Units)	14	14	8.79	10.195	10.61	11.3225	11.675	11.87	10.5	10.5

Values in grey and italics are below the laboratory limit of detection.

Appendix D3: Mixed Construction and Demolition Waste Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	24	14	*0.004*	*0.004*	0.0056	0.010025	0.01985	0.028	0.00849	0.00693
Arsenic	24	23	*0.001*	*0.002075*	0.0042	0.011125	0.02855	0.0378	0.00894	0.00505
Barium	24	24	0.33	1.18845	1.4829	1.771775	2.80221	2.8855	1.58	1.43
Cadium	24	1	*0.00009*	*0.001*	*0.001*	*0.001*	*0.001*	0.005	0.00113	0.000967
Chloride	23	23	*14.6*	35.2	45.4	54.1	95.69	104.09	48.7	43.6
Chromium	24	24	0.0637	0.24595	0.34245	0.48175	0.93598	1.2171	0.402	0.326
Copper	24	6	*0.007*	0.0176	0.03025	0.0705	0.62187	6	0.328	0.0468
DOC	24	24	15.7	33.975	52.15	80.275	197.62	245.3	72.3	55.4
Fluoride	23	23	0.1	1.005	2.6	4	5.84	8.5	2.67	1.73
Lead	24	4	*0.001*	*0.001*	*0.001*	*0.001*	0.00603	0.05	0.0033	0.00129
Mercury	24	17	*0.0001*	*0.0001*	0.00025	0.0008	0.00411	0.01	0.000992	0.000353
Molybdenum	24	23	*0.005*	0.014375	0.02525	0.045025	0.14589	0.2083	0.0459	0.0288
Nickel	24	14	*0.002*	*0.002*	0.0031	0.009575	0.094	0.0977	0.016	0.00551
Phenol	23	12	*0.01*	*0.01*	0.03	0.05	0.19	0.25	0.0557	0.0307
Selenium	24	23	*0.003*	0.004375	0.00575	0.01435	0.02925	0.039	0.0106	0.00779
Solids Total Dissolved	23	23	760	2170	3310	5185	8926	17010	4340	3370
Sulphate	24	24	23.3	222.025	642.4	1212.1	4282.93	7171.99	1240	596
Zinc	24	23	*0.03*	0.326325	0.4741	0.80645	1.210755	1.554	0.575	0.432
pH (pH Units)	1	1	-	-	-	-	-	*11.9*	-	-
Ethylbenzebe	1	0	-	-	-	-	-	*0.05*	-	-
MTBE	1	0	-	-	-	-	-	*0.05*	-	-
Benzene	1	0	-	-	-	-	-	*0.05*	-	-
Toulene	1	0	-	-	-	-	-	*0.05*	-	-
Total Xylenes	1	0	-	-	-	-	-	*0.1*	-	-
Total TPH	1	0	-	-	-	-	-	*0.1*	-	-
Total PAH	1	0	-	-	-	-	-	*0.00195*	-	-
PCBs	1	0	-	-	-	-	-	*0.002*	-	-

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D4: Rock by Product (Non Quarry) (Unwashed, Ground) Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	525	246	0.0079	*0.02*	*0.02*	0.06	0.15	0.47	0.0487	0.0353
Arsenic	525	86	0.0032	*0.025*	*0.025*	*0.025*	0.049	2.519	0.0357	0.027
Barium	525	416	*0.03*	0.04	0.12	0.22	0.33	1.01	0.145	0.103
Cadium	525	1	*0.00011*	*0.005*	*0.005*	*0.005*	*0.005*	0.007	0.00485	0.00442
Chloride	525	408	*3*	4	8	22	112.8	236	24.9	10.6
Chromium	525	70	*0.0005*	*0.015*	*0.015*	*0.015*	0.033	0.134	0.0174	0.0154
Copper	525	0	*0.0005*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*-*	*-*
DOC	525	170	*20*	*20*	20	30	50	180	26.5	24.4
Fluoride	525	11	1.3	*3*	*3*	*3*	5	24	3.42	3.28
Lead	525	4	*0.0005*	*0.05*	*0.05*	*0.05*	*0.05*	0.13	0.0487	0.0432
Mercury	525	4	*0.00005*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.0004	0.0000995	0.0000984
Molybdenum	525	513	*0.02*	0.11	0.2	0.3	0.47	1.53	0.22	0.173
Nickel	525	35	*0.0005*	*0.02*	*0.02*	*0.02*	0.03	0.08	0.0209	0.0193
Phenol	525	17	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.3*	*-*	*-*
Selenium	525	242	0.012	*0.03*	*0.03*	0.1	0.24	0.67	0.0757	0.0537
Solids Total Dissolved	525	518	350	940	1290	1719	3068.6	9615	1490	1290
Sulphate	525	520	5	197	458	789	1688	5519	590	333
Zinc	525	55	*0.003*	*0.03*	*0.03*	*0.03*	0.04	0.1	0.031	0.0294

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D5: Waste Stone (Unwashed, Ground)* Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	34	8	*0.0005*	*0.02*	*0.02*	*0.02*	0.047	0.08	0.0204	0.00975
Arsenic	34	10	*0.0002*	*0.025*	*0.025*	0.0275	0.1428	0.266	0.0367	0.0174
Barium	34	15	*0.0005*	*0.03*	*0.03*	0.06	0.1705	0.36	0.0542	0.0177
Cadium	34	0	*0.00011*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	-	-
Chloride	34	24	*3*	*5*	*10*	15	57.25	86	15.8	9.66
Chromium	34	5	*0.0005*	*0.015*	*0.015*	*0.015*	0.0244	0.044	0.0134	0.00783
Copper	34	1	*0.0005*	*0.07*	*0.07*	*0.07*	*0.07*	0.08	0.0557	0.0371
DOC	34	14	*20*	*20*	*20*	47.5	104	150	37.1	30
Fluoride	34	11	*1*	*3*	*3*	4	5.175	6	3.25	3.09
Lead	34	0	*0.0005*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Mercury	34	1	*0.00005*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.0009	0.000112	0.0000906
Molybdenum	34	29	0.0036	0.04125	0.07	0.11	0.147	0.2	0.0763	0.0599
Nickel	34	6	*0.0005*	*0.02*	*0.02*	*0.02*	0.0335	0.06	0.0179	0.00971
Phenol	34	8	*0.1*	*0.1*	*0.1*	*0.1*	0.3	0.3	0.147	0.129
Selenium	34	7	*0.0005*	*0.03*	*0.03*	*0.03*	0.1715	0.39	0.0452	0.0184
Solids Total Dissolved	34	34	200	470	620	897.5	1583.15	1810	730	648
Sulphate	34	32	*5*	17.75	49.5	180.25	692.95	964	147	54.6
Zinc	34	5	*0.003*	*0.03*	*0.03*	*0.03*	0.04	0.04	0.0248	0.0181
pH (pH Units)	1	0	-	-	-	-	-	9.24	-	-

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.
*One Sample washed and undergone chemical treatment

Table D6: Soil and Aggregates (Washed) Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Soil and Aggregates (Washed) Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	12	10	*0.008*	0.01875	0.022	0.02725	0.02945	0.03	0.0218	0.0205
Arsenic	12	11	0.011	0.045	0.087	0.11	0.128	0.15	0.077	0.063
Barium	12	11	*0.03*	0.06	0.072	0.11	0.2775	0.47	0.109	0.0834
Cadium	12	0	*0.00011*	*0.00011*	*0.00011*	*0.00011*	*0.005*	*0.005*	-	-
Chloride	12	11	*3*	10	25	37.75	75.35	110	29.9	19.4
Chromium	12	10	*0.015*	0.01875	0.0275	0.042	0.088	0.11	0.038	0.0309
Copper	12	10	0.0071	0.023	0.0395	0.052	0.07	0.07	0.0384	0.032
DOC	12	0	*20*	*50*	*50*	*50*	*50*	*50*	45	42.9
Fluoride	12	10	1.7	2.075	2.25	2.4	*3*	*3*	2.29	2.26
Lead	12	0	*0.0005*	*0.0005*	*0.0005*	*0.0005*	*0.05*	*0.05*	-	-
Mercury	12	0	*0.00005*	*0.00005*	*0.00005*	*0.00005*	*0.0001*	*0.0001*	-	-
Molybdenum	12	11	*0.02*	0.063	0.108	0.165	0.208	0.23	0.115	0.0924
Nickel	12	9	0.0005	0.007475	0.0108	*0.02*	0.03345	0.034	0.0146	0.00993
Phenol	12	0	*0.1*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	-	-
Selenium	12	9	0.0005	0.011	0.0145	0.02025	*0.03*	*0.03*	0.0158	0.0118
Solids Total Dissolved	12	11	350	625	1350	1525	1645	1700	1110	977
Sulphate	12	12	36	307.5	450	677.5	771.5	810	455	338
Zinc	12	1	0.003	0.003	0.003	0.003	0.0525	0.08	0.0117	0.00478
Ammonium	10	10	0.81	1.125	1.4	1.975	2.925	3.6	-	-
Boron	2	1	0.12	-	-	-	-	0.14	-	-

Values in grey and italics are below the laboratory limit of detection.

Dataset obtained from multiple sources with different laboratory limits of detection.

Table D7: Natural Aggregate (Virgin, Unwashed, Ground) Summary Statistics for 10:1 L/S Ratio Leachate Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Antimony	15	9	*0.01*	*0.01*	0.0175	0.04245	0.05279	0.06	0.0258	0.0205
Arsenic	15	9	*0.005*	*0.005*	0.014	0.0162	0.01792	0.0193	0.0117	0.0101
Barium	15	5	0.367	0.617	0.667	1.75	2.498	3.47	1.19	0.952
Cadium	15	1	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	-	-
Chloride	15	8	*20*	*20*	27	47	54.8	56	32	29.4
Chromium	15	2	*0.01*	*0.01*	*0.01*	*0.01*	0.01048	0.0112	0.0101	0.0101
Copper	15	5	*0.003*	*0.003*	*0.003*	0.00332	0.011508	0.021	0.0047	0.00379
DOC	15	0	*30*	*30*	*30*	*30*	*30*	*30*	-	-
Fluoride	15	5	*5*	*5*	*5*	*5*	7.344	8.34	5.49	5.42
Lead	15	3	*0.002*	*0.002*	*0.002*	*0.002*	0.014888	0.0242	0.00422	0.00271
Mercury	15	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Molybdenum	15	6	*0.03*	*0.03*	*0.03*	0.0457	0.08962	0.115	0.0426	0.0383
Nickel	15	8	*0.004*	*0.004*	*0.004*	0.00492	0.012498	0.0171	0.00572	0.00507
Phenol	15	0	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	*0.16*	-	-
Selenium	15	3	*0.01*	*0.01*	*0.01*	*0.01*	0.0119	0.0122	0.0103	0.0103
Solids Total Dissolved	15	15	279	481	578	1330	2270	3500	991	764
Sulphate	15	15	20	65	180	613	1298	2270	430	186
Zinc	15	11	*0.01*	*0.01*	0.0182	0.032	0.5046	0.528	0.114	0.0326
pH (pH Units)	14	14	8	8.3725	9.1	9.69	9.9205	9.97	9.05	9.03
Aluminium	15	14	0.385	1.12	1.18	1.59	12.5	15.8	3.03	1.64
Berylium	15	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Boron	15	7	*0.1*	*0.1*	*0.1*	0.113	0.127	0.145	0.107	0.107
Cobalt	15	1	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	-	-
Lithium	15	8	*0.01*	*0.01*	*0.01*	0.0439	0.04804	0.0487	0.0228	0.0179
Manganese	15	7	*0.03*	*0.03*	*0.03*	0.0576	0.2774	0.449	0.0813	0.0516
Phosphorus	15	7	*0.1*	*0.1*	*0.1*	0.23	0.368	0.485	0.182	0.156
Strontium	15	11	0.641	0.79	1.87	3.04	18.14	38.9	4.84	2.09
Thallium	15	1	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Titanium	15	5	*0.01*	*0.01*	*0.01*	0.0115	0.02	0.0254	0.0121	0.0116
Vanadium	15	3	*0.01*	*0.01*	*0.01*	*0.01*	0.01362	0.0153	0.0106	0.0105
Silver	15	3	*0.005*	*0.005*	*0.005*	*0.005*	0.005646	0.00606	0.00511	0.0051
Sodium	15	15	13.2	16.7	18.4	26.2	29.06	32.6	20.7	19.9
Magnesium	15	15	7.43	9.62	11.5	23.6	31.4	41	16.6	14.3
Potassium	15	4	2.13	3.03	3.48	13.9	14.58	15	7.03	5.34
Calcium	15	15	65.9	78.4	143	281	496	799	213	159
Iron	15	3	*0.19*	*0.19*	*0.19*	*0.19*	4.986	6.9	0.977	0.315
Chromium VI	15	0	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	-	-

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D8: Concrete (Unground, Waste) Summary Statistics for Total Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Mineral Oil	32	6	*30*	*30*	*30*	*52*	86	265	44	36.7

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D9: Concrete (Unwashed, Ground, Waste) Summary Statistics for Total Data for industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Loss on Ignition (%)	30	29	0.749	2.33	2.68	4.23	4.674	10.4	3.06	2.57
Acid Neutralisation capacity (pH4)(mol/Kg)	33	32	0.135	0.5935	0.813	1.0825	1.601	1.78	0.86	0.731
Acid Neutralisation capacity (pH7)(mol/Kg)	32	31	0.103	0.3025	0.385	0.5175	0.5765	0.621	0.387	0.356
BTEX Sum	17	0	*0.5*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	-	-
Benzene	17	1	*0.18*	*0.18*	*0.18*	*0.18*	0.244	0.5	0.199	0.191
Ethylbenzene	17	1	*0.08*	*0.08*	*0.08*	*0.08*	0.164	0.5	0.105	0.0891
Toluene	59	25	*0.0001*	*0.001*	0.017	*0.14*	*0.14*	0.5	0.0574	0.0131
m-&p-Xylene	17	1	0.2	0.2	0.2	0.2	0.26	0.5	0.218	0.211
o-Xylene	17	1	*0.2*	*0.2*	*0.2*	*0.2*	0.26	0.5	0.218	0.211
Xylene Total	1	0	-	-	-	-	-	*0.5*	-	-
Mineral oil by Calculation	43	5	*10*	*10*	*10*	*10*	46.6	130	15.7	12.1
PAHs Solid (Sum of 17)	33	7	*0.05*	*0.318*	*0.318*	*0.318*	4.1	6.3	0.856	0.444
PCBs	108	0	*0.005*	*0.021*	*0.035*	*0.1*	*0.1*	*0.1*	-	-
pH	33	33	8.41	8.89	11.6	12.6	12.8	12.8	10.8	10.7
TOC (%)	81	67	0.2	0.22	0.42	0.8	2.7	3.7	0.763	0.506
MTBE	16	0	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	*0.2*	-	-
Antimony	24	0	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	-	-
Arsenic	24	24	2.29	3.385	4.25	11.175	22.155	29.1	8.59	6.08
Barium	24	24	50.4	67.525	81.25	91.95	543.05	627	156	105
Cadmium	24	24	0.195	0.30225	0.463	0.65825	1.6325	3.06	0.644	0.505
Chromium	24	24	3.55	7.81	10.45	12.025	13.24	29.2	9.99	8.82
Copper	24	24	1.4	5.605	8.505	21.325	24.81	26	11.9	8.38
Lead	24	24	1.14	5.6175	6.84	38.45	74.385	666	47.1	12.5
Mercury	24	0	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	0.14	0.14	0.14
Molybdenum	24	21	0.1	0.57925	0.7465	0.794	0.94935	0.972	0.646	0.541
Nickel	24	24	4.83	11.025	15.25	17.775	20.36	26.6	14.1	12.9
Selenium	24	6	*1*	*1*	*1*	1.0225	1.355	1.39	1.06	1.05
Vanadium	24	24	1.51	15.7	20.75	23.7	26.24	28.4	18.1	13.5
Zinc	24	24	19	31.4	44.85	93.65	555.35	674	123	63.8
Boron, water soluble	32	3	*1*	*1*	*1*	*1*	1.066	1.16	1.01	1.01
Chromium, Hexavalent	32	5	*0.6*	*0.6*	*0.6*	*0.6*	0.79435	1.08	0.634	0.628
Aluminium	32	32	35.3	1464	4965	6040	7073.5	7170	4050	2200
Beryllium	32	32	0.139	0.23125	0.415	0.51275	0.59085	0.603	0.387	0.353
Cobalt	32	32	0.242	1.4775	3.055	3.97	5.6485	6.48	2.96	2.32
Iron	32	32	2420	4390	5930	7617.5	13015	20800	6840	5970
Manganese	32	32	0.13	449.25	584.5	824	2262	2350	819	529
Phosphorus	32	32	99.9	129	168	211.25	420.25	492	203	182
Strontium	32	32	184	255.5	368.5	419.5	660.9	740	365	339
Tin	32	22	0.24	0.24	0.516	0.664	1.7835	2.31	0.645	0.509
Thallium	32	8	*0.7*	*0.7*	*0.7*	0.7125	3.467	3.74	1.06	0.882
Titanium	32	25	0.1	53.725	228	346.75	425.5	484	222	40.7
Lithium	32	32	14.2	75.275	80.9	105	125	126	87.1	82.2
Total Aliphatics >C5-C10	16	1	*0.05*	*0.05*	*0.05*	*0.05*	0.052275	0.0591	0.0506	0.0505
Total Aromatics >EC5-EC10	16	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Gasoline Range Organics >C5-C10	16	1	*0.02*	*0.02*	*0.02*	*0.02*	0.029775	0.0591	0.0224	0.0214
Total Aliphatics >C10-C44	32	12	*5*	*5*	*5*	9.9675	17.945	25.5	8.07	7.04
Total Aromatics > EC10-EC44	32	5	*5*	*5*	*5*	*5*	25.4	30.6	7.76	6.25
Silver	8	0	*10*	*10*	*10*	*10*	*10*	*10*	-	-
Sodium	8	8	163	168.75	173	194.75	230.7	244	186	184
Magnesium	8	8	2950	3385	3855	4722.5	4773	4780	3950	3880
Potassium	8	8	139	207.75	223.5	244	276.5	294	220	216
Calcium	8	8	309000	320250	332500	351750	356600	358000	334000	334000

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D10: Mixed Construction and Demolition Material (Unwashed, Waste) Summary Statistics for Total Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Loss on Ignition (%)	5	5	1.3	2	2.04	3.1	3.34	3.4	2.37	2.24
Acid Neutralisation capacity (pH4)(mol/Kg)	5	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Acid Neutralisation capacity (pH7)(mol/Kg)	5	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Benzene	22	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
BTEX	23	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Ethylbenzene	22	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Toluene	22	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
m-&p-Xylene	22	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
o-Xylene	22	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Xylene Total	22	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	0.5	0.5
Mineral oil by Calculation	23	4	2.5	2.5	2.5	2.5	213.1	295	26.3	4.18
PAHs Solid (Sum of 17)	23	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
PCBs	23	0	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	-	-
pH	23	23	7.8	9	10.4	11.8	12.19	12.4	10.4	10.3
TOC (%)	23	2	*1*	*1*	*1*	*1*	1.45	1.5	1.04	1.04

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D11: Rock By Product (Unwashed) Summary Statistics for Total Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
BTEX Sum	552	16	*0.001*	*0.025*	*0.025*	*0.025*	*0.025*	0.5	0.0255	0.0244
Mineral oil by Calculation	552	27	*10*	*45*	*45*	*45*	*45*	399	46	42.7
PAH (sum of 6	508	17	*0.22*	*0.22*	*0.22*	*0.22*	*0.22*	10.63	0.267	0.231
PAHs Solid (Sum of 17)	552	35	*0.05*	*0.64*	*0.64*	*0.64*	1.5775	22.16	0.755	0.643
PCBs	552	1	*0.005*	*0.035*	*0.035*	*0.035*	*0.035*	*0.1*	-	-
TOC (%)	549	549	0.02	0.54	0.71	0.94	1.416	3.3	0.779	0.697
Arsenic	544	544	1.5	8.8	11.1	14.4	22.225	78	12.4	11.1
Cadmium	543	537	0.064	1.1	1.8	2.5	5.49	23.6	2.17	1.67
Chromium	544	544	4.29	19.775	28	39.15	64.7	132.9	31.3	27.1
Copper	544	544	4.9	19	24	29	40	74	24.9	23.3
Lead	544	542	*0.1*	12	17	22	34.85	155	18.4	16.1
Mercury	544	22	*0.0025*	*0.1*	*0.1*	*0.1*	*0.1*	2.2	0.105	0.0929
Molybdenum	475	472	0.9	4	5.6	7.75	12.13	39	6.3	5.51
Nickel	544	544	9.9	30.9	39.45	48.925	64.155	120.1	40.4	38
Selenium	544	484	*0.01*	*1*	2	4	8	20	2.95	2.28
Vanadium	476	476	5	19	24	29	40	108	24.7	23.1
Zinc	544	544	9	65	86	112	184.1	1330	99.4	84.8

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D12: Waste Stone (Waste, Unwashed, Ground) Summary Statistics for Total Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
BTEX Sum	42	2	*0.01*	*0.01*	*0.025*	*0.025*	*0.025*	0.056	0.0216	0.0197
Mineral oil by Calculation	50	5	*10*	11.25	*45*	*45*	89	1755	73.4	33.4
PAH (sum of 6	26	6	*0.22*	*0.22*	*0.22*	*0.22*	5.1625	7.03	0.895	0.364
PAHs Solid (Sum of 17)	51	8	*0.64*	*0.64*	*0.64*	2	5.15	13.64	1.81	1.2
PCBs	51	2	*0.035*	*0.035*	*0.035*	*0.1*	*0.1*	3.8	0.129	0.0521
TOC (%)	51	51	0.17	0.385	0.59	1.375	4.75	6	1.26	0.76
Arsenic	54	54	3.4	10.025	13	17.975	34.1	40	15.3	13.2
Cadmium	54	49	*0.1*	0.5525	1.55	1.975	2.845	4.6	1.39	0.986
Chromium	54	54	7.7	20.475	28.85	41.7	53.2	61	30.9	27.5
Copper	54	54	9	18	25.5	32.75	52.8	71	27.4	24.8
Lead	54	54	9	17	27	38.5	94.7	199	36.8	28.9
Mercury	54	5	*0.1*	*0.1*	*0.1*	*0.1*	0.127	0.3	0.109	0.105
Molybdenum	37	37	0.7	2.2	3	3.8	5.2	6.2	3.04	2.71
Nickel	54	54	15.4	31.125	37.55	45.625	67.105	120	39.9	37.1
Selenium	46	30	*0.24*	*1*	*1*	1.875	4.75	5.3	1.55	1.25
Vanadium	37	37	6.6	18	24	30	35.2	39	23.9	22.4
Zinc	53	53	23	53	79	103	175.8	299	89.4	77.8

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D13: Natural Aggregate (Virgin Material, Unwashed, Ground) Summary Statistics for Total Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Loss on Ignition (%)	15	6	*0.7*	*0.7*	*0.7*	0.8055	3.3883	9.22	1.31	0.876
Acid Neutralisation capacity (pH4)(mol/Kg)	15	15	0.26	0.69	1.09	1.445	1.724	1.78	1.05	0.914
Acid Neutralisation capacity (pH7)(mol/Kg)	15	15	0.147	0.292	0.387	0.4355	0.5751	0.58	0.372	0.347
BTEX Sum	7	1	*0.8*	*0.8*	*0.8*	*0.8*	5.84	8	1.83	1.11
Benzene	7	1	*0.18*	*0.18*	*0.18*	*0.18*	1.314	1.8	0.411	0.25
Toluene	7	1	*0.14*	*0.14*	*0.14*	*0.14*	1.022	1.4	0.32	0.195
Ethylbenzene	7	1	*0.08*	*0.08*	*0.08*	*0.08*	0.584	0.8	0.183	0.111
m-&p-Xylene	7	1	*0.2*	*0.2*	*0.2*	*0.2*	1.46	2	0.457	0.278
o-Xylene	7	1	*0.2*	*0.2*	*0.2*	*0.2*	1.46	2	0.457	0.278
MTBE (mg/Kg)	7	1	*0.2*	*0.2*	*0.2*	*0.2*	1.46	2	0.457	0.278
PAHs Solid (Sum of 17)	15	0	*0.318*	*0.318*	*0.318*	*0.318*	*0.318*	*0.318*	-	-
PCBs	15	0	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*	-	-
pH	15	15	8.24	8.53	8.89	9.335	9.547	9.68	8.92	8.91
TOC (%)	15	8	*0.2*	*0.2*	0.215	0.376	0.4918	0.496	0.28	0.262
Antimony	11	1	*0.6*	*0.6*	*0.6*	*0.6*	1.3	2	0.727	0.669
Arsenic	11	11	3.28	6.245	12.9	21.55	22.05	22.2	13.4	11
Barium	11	11	17.5	44.5	104	522	586	627	241	122
Cadmium	11	11	0.035	0.4555	0.68	0.996	2.38	3.06	0.903	0.573
Chromium	11	11	2.6	3.285	3.69	4.9	9.435	10.5	4.71	4.25
Copper	11	8	*1.4*	1.555	2.06	16.45	18.65	18.7	7.56	4.1
Lead	11	11	3.44	11.05	14	52.3	70.15	76.2	30.7	20.2
Mercury	11	0	*0.1*	*0.14*	*0.14*	*0.14*	*0.14*	*0.14*	-	-
Molybdenum	11	6	*0.1*	*0.1*	0.104	0.59	2.4815	4.2	0.629	0.245
Nickel	11	11	1.21	5.055	6.74	14	17.85	19.9	9.32	6.96
Selenium	9	5	*1*	*1*	1.14	1.27	1.382	1.39	1.15	1.14
Vanadium	11	11	1.24	1.545	1.61	16.55	21.7	24.5	7.92	3.78
Zinc	11	4	26	57.05	105	375	618.5	674	230	131
Boron, water soluble	15	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Chromium, Hexavalent	15	0	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	-	-
Aluminium	15	15	35.3	243.5	306	656.5	862.9	1110	443	330
Beryllium	15	15	0.139	0.1565	0.174	0.207	0.2224	0.249	0.181	0.178
Cobalt	15	15	0.242	0.493	0.762	1.16	1.371	1.56	0.833	0.737
Iron	15	14	*1000*	2090	2730	4325	5654	5990	3130	2710
Manganese	15	15	0.13	203	269	1490	2350	2350	917	328
Phosphorus	15	15	67.7	93.05	105	120.5	133.3	141	106	104
Strontium	15	15	184	201	233	848.5	956.9	1050	513	400
Tin	15	0	*0.24*	*0.24*	*0.24*	*0.24*	*0.24*	*0.24*	-	-
Thallium	15	15	0.7	0.7	0.75	1.875	3.572	3.74	1.46	1.15
Titanium	15	2	*0.1*	*0.1*	*0.1*	*0.1*	*1*	*1*	0.22	0.136
Lithium	15	15	96.7	113.5	120	123.5	125.3	126	116	116
Total Aliphatics >C5-C10	7	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Total Aromatics >EC5-EC10	7	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
GRO >C5-C10	7	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Total Aliphatics >C10-C44	15	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Total Aromatics > EC10-EC44	15	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Silver	11	0	*10*	*10*	*10*	*10*	*10*	*10*	-	-
Sodium	11	11	164	182.5	193	206	229.5	244	197	196
Magnesium	11	11	2950	3455	5810	8440	10250	10400	6190	5590
Potassium	11	11	139	222	284	340.5	415.5	450	283	268
Calcium	11	11	248000	296000	315000	333000	356000	361000	311000	309000

Values in grey and italics are below the laboratory limit of detection
Dataset obtained from multiple sources with different laboratory limits of detection.

Table D14: Waste Soil, Aggregate and Stone (Waste) Summary Statistics for Total Data for Industry Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Loss on Ignition (%)	14	13	1	1.625	2.1	2.35	2.775	3.1	1.96	1.87
Acid Neutralisation capacity	11	11	0.012	0.0165	0.029	0.0395	0.055	0.065	0.0302	0.0262
BTEX	15	0	*0.01*	*0.01*	*0.01*	*0.0175*	*0.025*	*0.025*	-	-
Benzene	16	0	*0.001*	*0.001*	*0.001*	*0.005*	*0.005*	*0.005*	-	-
Toluene	16	2	*0.001*	*0.001*	*0.001*	*0.005*	*0.005*	*0.005*	0.00241	0.00184
Ethylbenzene	16	0	*0.001*	*0.001*	*0.001*	*0.005*	*0.005*	*0.005*	-	-
m-&p-Xylene	16	0	*0.001*	*0.001*	*0.001*	*0.005*	*0.005*	*0.005*	-	-
o-Xylene	16	0	*0.001*	*0.001*	*0.001*	*0.005*	*0.005*	*0.005*	-	-
MTBE	16	0	*0.001*	*0.001*	*0.001*	*0.005*	*0.005*	*0.005*	-	-
Mineral oil by Calculation	16	0	*10*	*10*	*10*	*30*	*30*	*30*	-	-
PAH (sum of 6	4	1	*0.22*	*0.22*	*0.22*	0.76	2.056	2.38	0.76	0.399
PAHs Solid (Sum of 17)	17	13	0.044042	0.72	5.9	22	48.4	54	14.5	4.49
PCBs	16	0	*0.01*	*0.035*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
pH	16	16	8.5	8.8625	9.075	9.4	10.6	12.1	9.31	9.28
TOC (%)	16	16	0.17	0.6925	1.205	1.625	2.2475	2.39	1.2	0.937
Antimony	15	5	*1*	*2*	*2*	*2*	2.06	2.2	1.81	1.75
Arsenic	15	15	5.3	8.75	12	18	24.7	31	14.2	12.7
Barium	15	15	22	40	56	76	118.8	123	62.5	55.3
Cadmium	15	15	0.28	0.56	0.9	1.15	1.39	1.6	0.877	0.793
Chromium	15	15	3.9	7.9	16	31.8	80.44	82.4	25.9	16.3
Copper	15	15	11	19.5	29	37	160	300	49.8	31.6
Lead	15	15	8	27	66	96	211	260	79.1	53.6
Mercury	15	7	*0.05*	*0.05*	0.06	*0.1*	0.193	0.2	0.0933	0.0808
Molybdenum	15	14	*0.5*	1.2	1.4	2.7	4.98	5.4	2.15	1.74
Nickel	15	15	7.1	14	19	24.3	31.11	40.7	19.5	17.7
Selenium	15	10	*0.25*	0.335	0.66	0.985	1	1	0.646	0.565
Zinc	15	15	37	67.5	90	130	190	260	103	90.1
Boron, water soluble	14	10	*0.4*	0.41	0.475	0.6925	1.1615	2	0.624	0.556
Chromium, Hexavalent	14	0	*0.3*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Chromium III mg/kg	14	14	3.9	7.7	13	18	80.58	82.4	24.4	15.2
Total aliphatics C5-35	8	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Total aromatics C5-35	8	1	*5*	*5*	*5*	*5*	25.8	37	9	6.42
Total aliphatics and aromatics(C5-40) (EH+HS_CU_	13	1	*10*	*10*	*10*	52	52	52	26.6	20
Total aliphatics C5-35	5	1	*5*	*5*	19	26	30	31	17.2	13.1
Total aromatics C5-35	5	0	*5*	*5*	*5*	19	24.6	26	12	9.08
TPH total WAC	11	2	*10*	*10*	*10*	*10*	34	37	14.4	12.5
Aliphatic TPH >C5-C6	1	0	-	-	-	-	-	*1*	-	-
Aliphatic TPH >C6-C8	3	0	*1*	-	*1*	-	-	*1*	-	-
Aliphatic TPH >C8-C10	3	0	*1*	-	*1*	-	-	*1*	-	-
Aliphatic TPH >C10-C12	3	0	*1*	-	*1*	-	-	*1*	-	-
Aliphatic TPH >C12-C16	3	0	*1*	-	*1*	-	-	*1*	-	-
Aliphatic TPH >C16-C21	3	0	*1*	-	*1*	-	-	*1*	-	-
Aliphatic TPH >C21-C35	3	0	*1*	-	*1*	-	-	*1*	-	-
Aliphatic TPH >C35-C44	3	0	*1*	-	*1*	-	-	*1*	-	-
Aromatic TPH >C5-C7	3	0	*1*	-	*1*	-	-	*1*	-	-
Aromatic TPH >C7-C8	3	0	*1*	-	*1*	-	-	*1*	-	-
Aromatic TPH >C8-C10	3	0	*1*	-	*1*	-	-	*1*	-	-
Aromatic TPH >C10-C12	3	0	*1*	-	*1*	-	-	*1*	-	-
Aromatic TPH >C12-C16	3	0	*1*	-	*1*	-	-	*1*	-	-
Aromatic TPH >C16-C21	3	0	*1*	-	*1*	-	-	*24*	-	-
Aromatic TPH >C21-C35	3	0	*1*	-	*1*	-	-	*7.7*	-	-
Aromatic TPH >C35-C44	3	0	*1*	-	*1*	-	-	*1*	-	-
Total Sulphate as SO4 #	15	15	0.071	0.155	0.31	188.175	1334.7	3238	306	1.72
Sulphur mg/kg	14	14	3.5	4.85	12	18.75	30.85	38	14.1	10.6
Sulphide mg/kg	14	14	9.5	10	12.5	14	38.25	74	16.8	13.8
Cyanide mg/kg	14	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Phenol mg/kg	14	0	*0.01*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Acenaphthene	12	7	*0.05*	*0.1*	0.125	0.4175	0.9095	1.3	0.312	0.196
Acenaphthylene	12	5	*0.03*	*0.1*	*0.1*	0.14	0.279	0.4	0.137	0.116
Anthracene	12	9	*0.04*	0.2575	0.5	1.125	1.47	1.8	0.683	0.42
Benzo[a]anthracene	12	9	*0.06*	0.325	1.35	2.1	3.105	3.6	1.35	0.709
Benzo[a]pyrene	12	9	*0.04*	0.3025	1.35	1.85	3.24	3.9	1.32	0.654
Benzo[b]fluoranthene	12	9	*0.05*	0.2425	1.6	2.375	3.94	4.6	1.6	0.731
Benzo[g,h,i]perylene	12	7	*0.04*	*0.1*	0.8	1.175	1.825	2.1	0.763	0.389
Benzo[k]fluoranthene	12	9	*0.02*	0.1075	0.54	0.8925	1.48	1.7	0.603	0.327
Chrysene	12	9	*0.04*	0.3175	1.3	2.15	3.59	3.7	1.41	0.69
Dibenz(a,h)Anthracene	12	7	*0.04*	*0.1*	0.17	0.23	0.5435	0.56	0.214	0.166
Fluoranthene	12	9	*0.1*	0.8825	3.4	4.65	8.23	9	3.3	1.68
Fluorene	12	7	*0.04*	*0.1*	0.295	0.4875	0.828	0.96	0.337	0.227
Indeno(1,2,3-c,d)Pyrene	12	7	*0.04*	*0.1*	0.755	1.0525	1.97	2.3	0.762	0.384
Naphthalene	12	7	*0.04*	*0.1*	0.36	0.655	2.985	4.8	0.778	0.31
Phenanthrene	12	10	*0.09*	1.075	2.75	4.65	10.195	13	3.58	1.49
Pyrene	12	12	*0.07*	0.81	2.95	4	7.325	7.6	2.91	1.49
Coronene	11	0	*0.04*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-

Values in grey and italics are below the laboratory limit of detection.
Dataset obtained from multiple sources with different laboratory limits of detection.

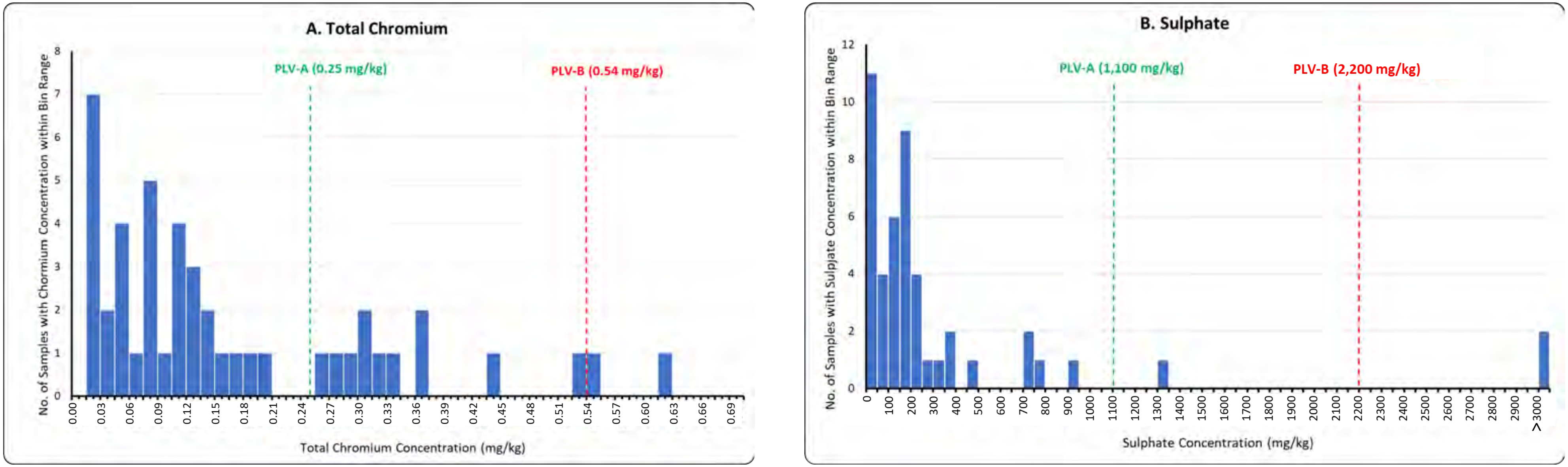

Figure D1 – Frequency Distribution Plots for Concrete (Not Ground) Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

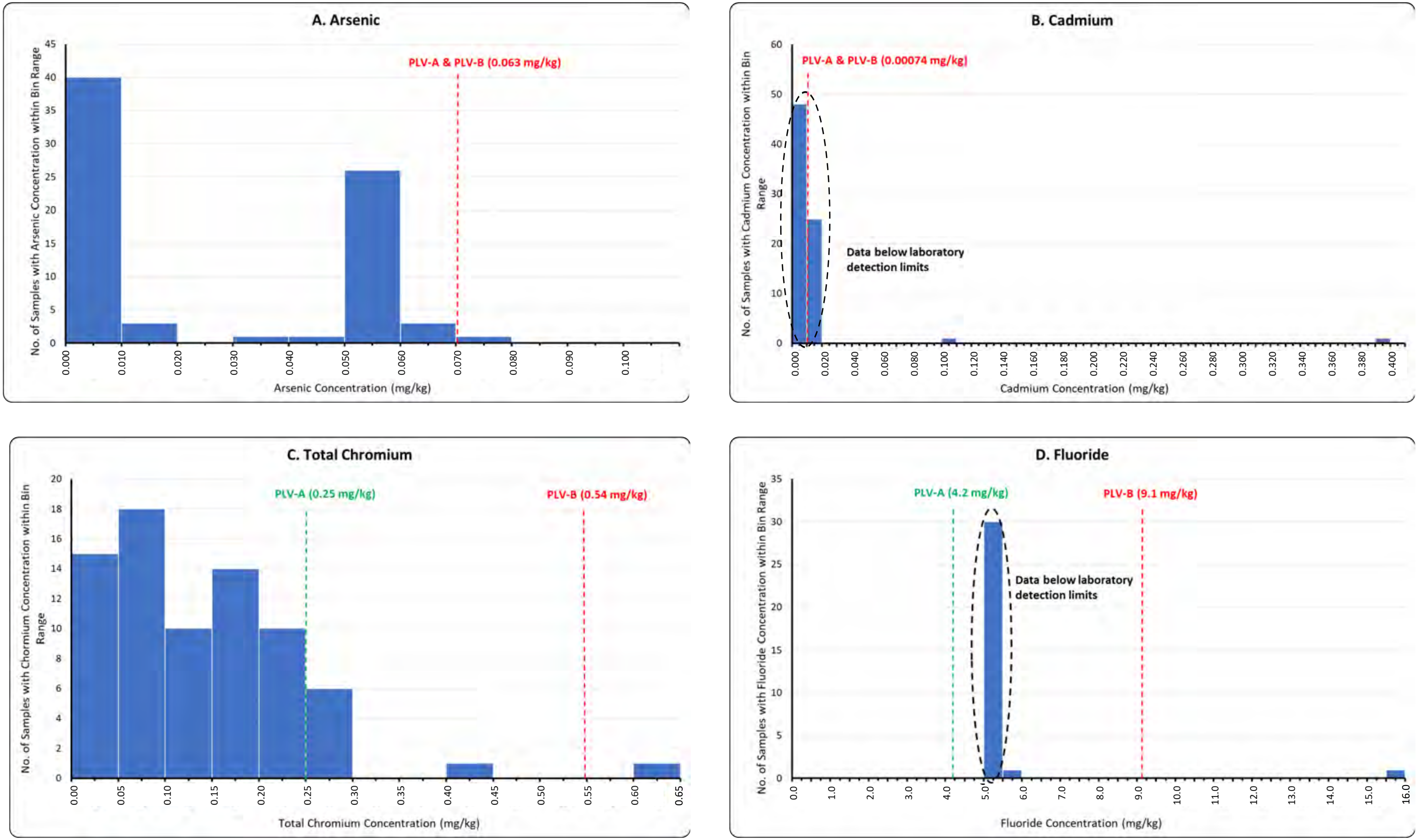

Figure D2a – Frequency Distribution Plots for Concrete (Ground) Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

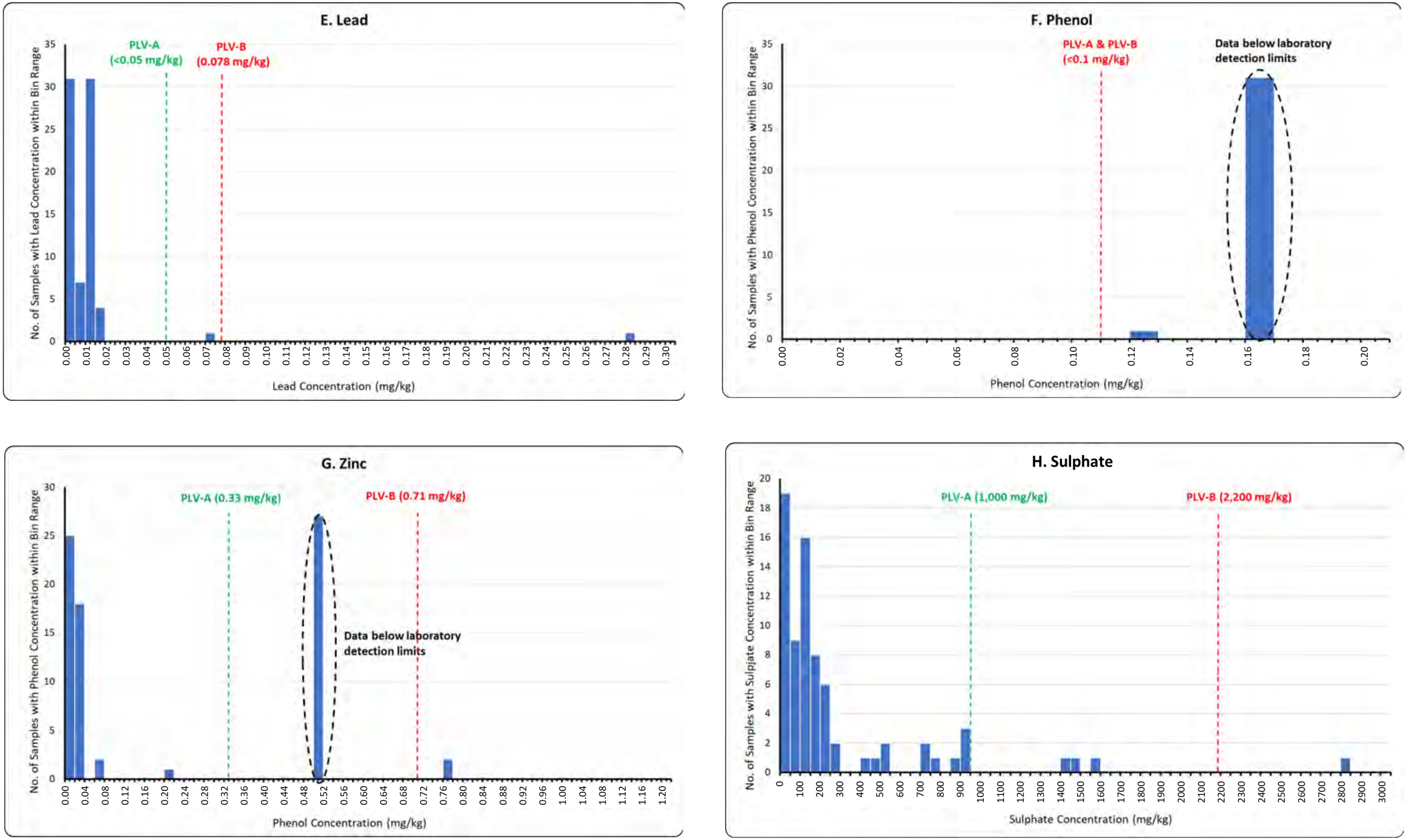

Figure D2b – Frequency Distribution Plots for Concrete (Ground) Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

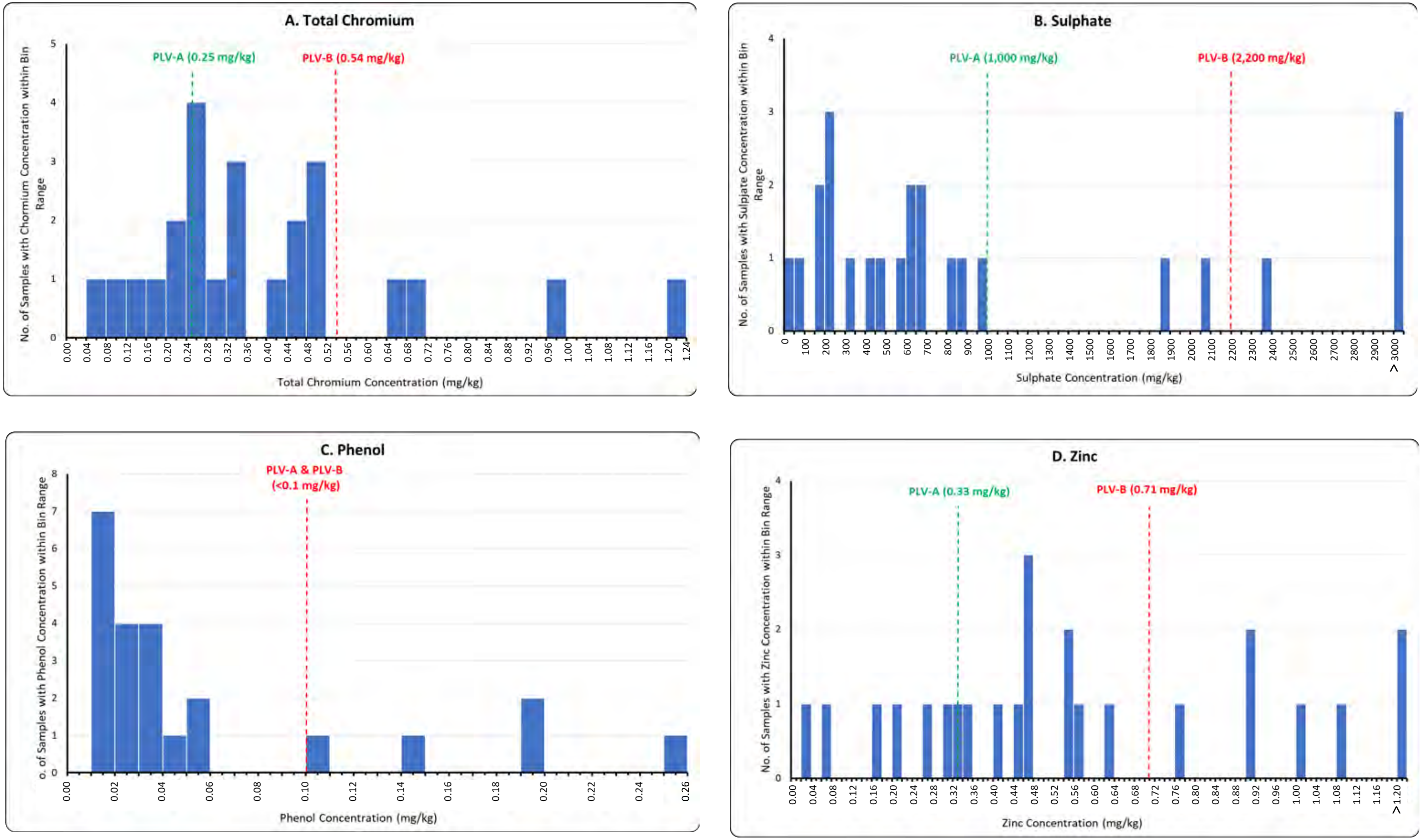

Figure D3 – Frequency Distribution Plots for Mixed Construction & Demolition Material Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

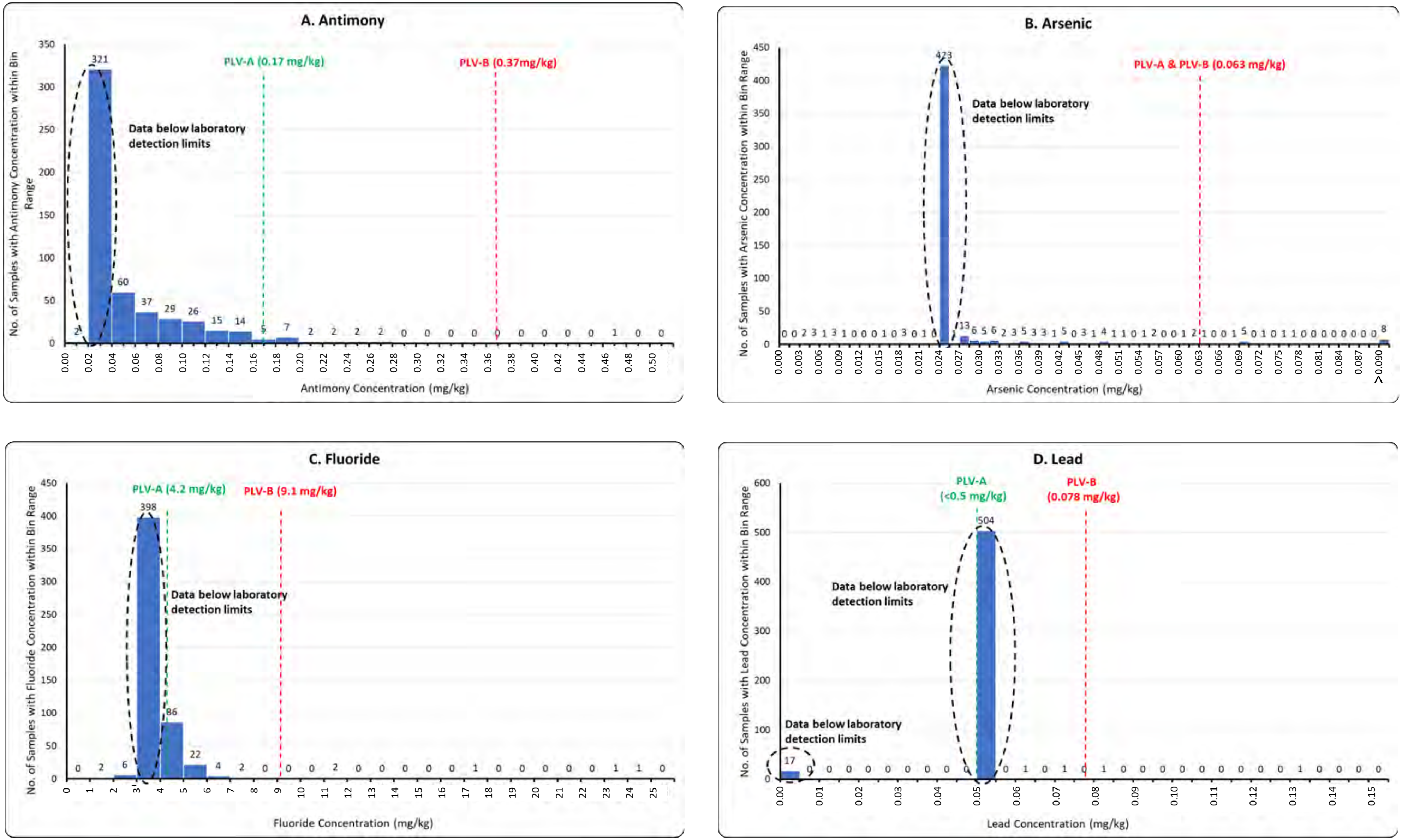

Figure D4a – Frequency Distribution Plots for Rock By Product Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

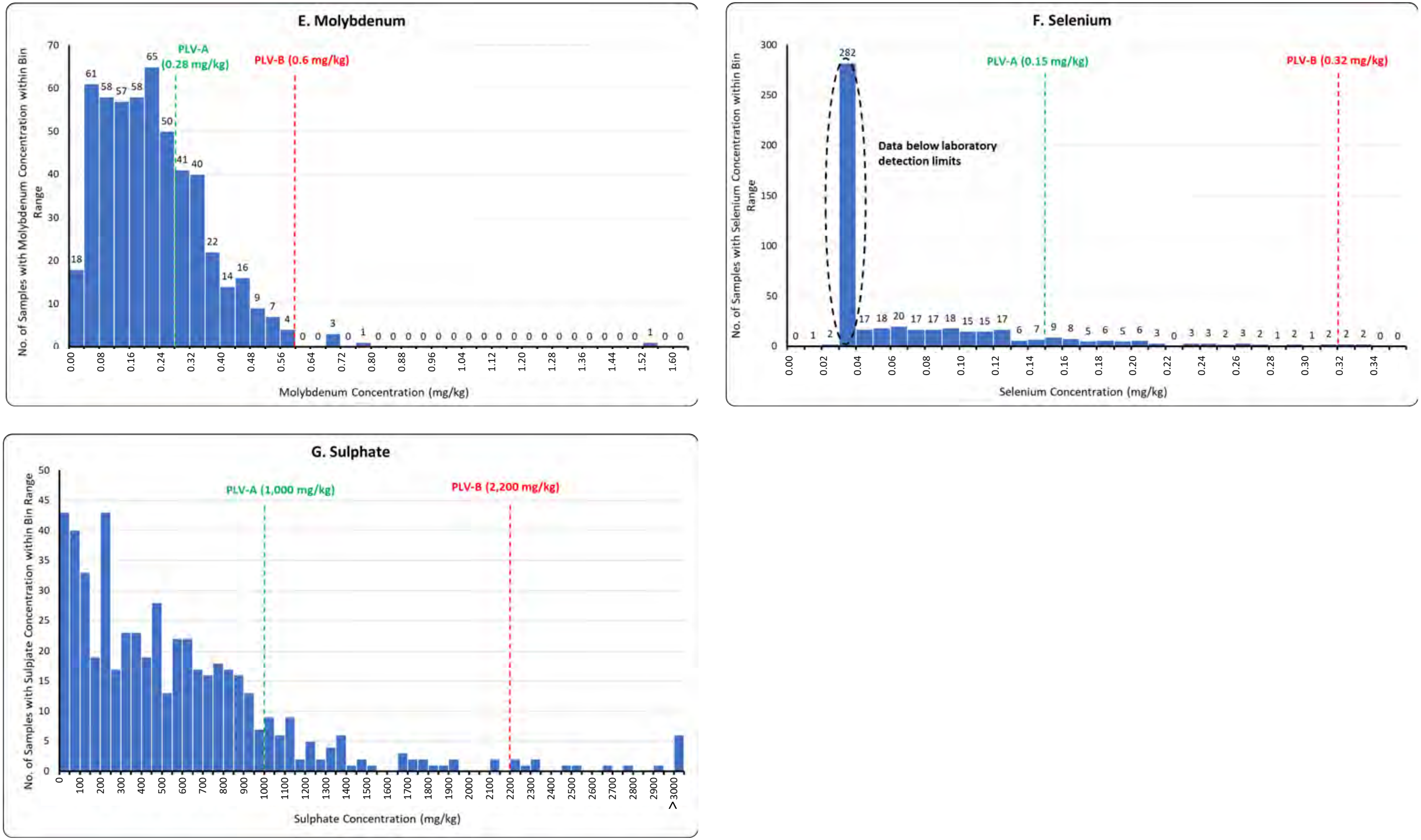

Figure D4b – Frequency Distribution Plots for Rock By Product Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

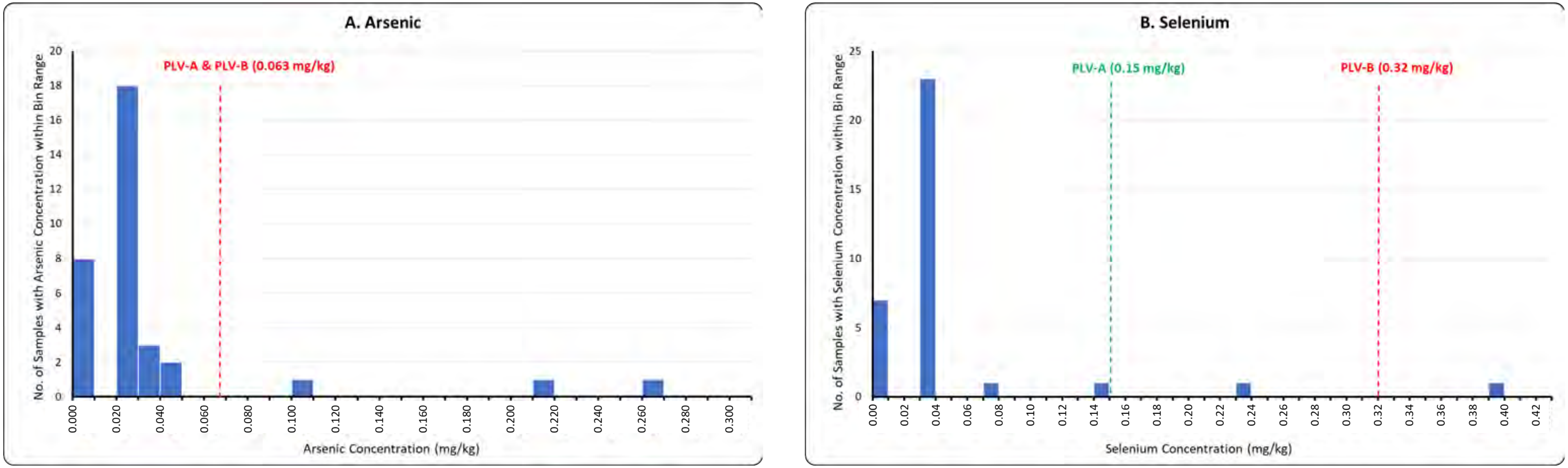

Figure D5 – Frequency Distribution Plots for Waste Stone Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

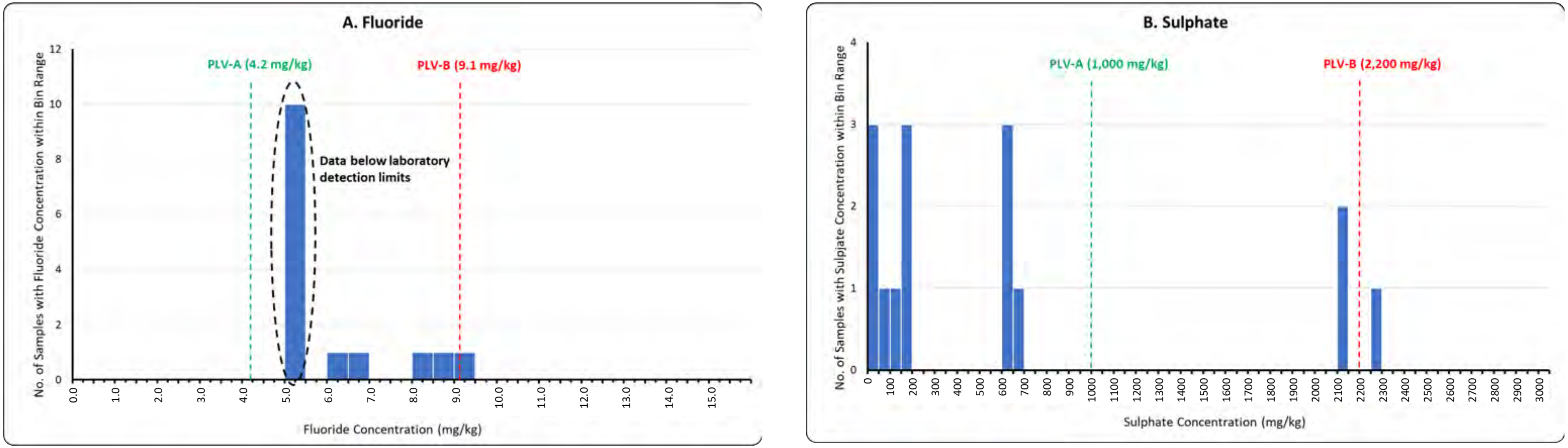

Figure D6 – Frequency Distribution Plots for Natural Aggregate Data from Industry Dataset vs :Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

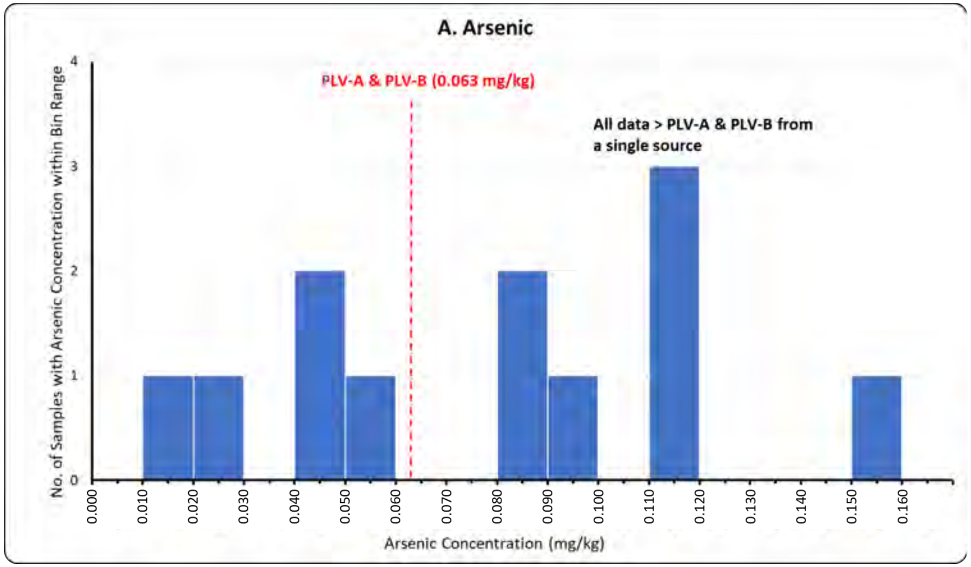

Figure D7 – Frequency Distribution Plots for Waste Soil and Aggregate Data from Industry Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

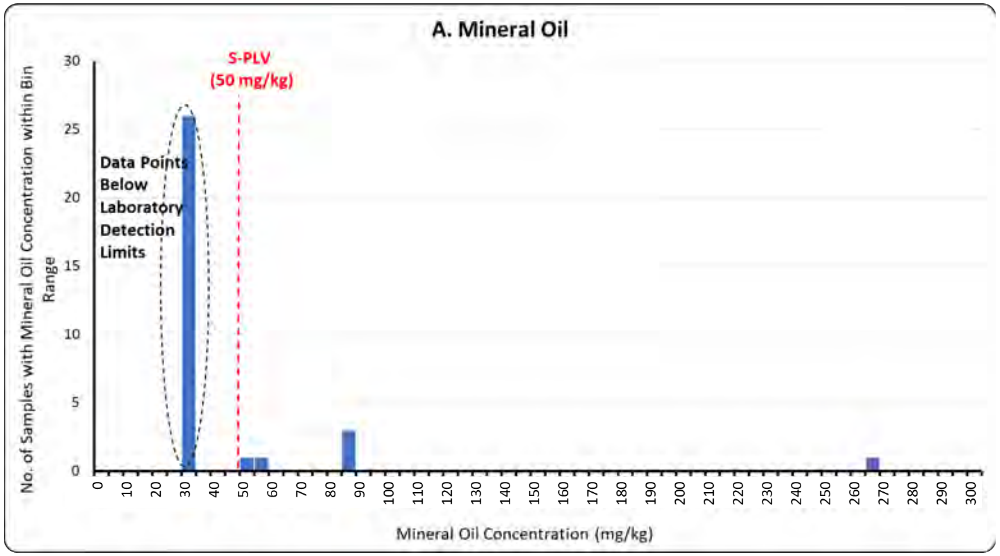

Figure D8 – Frequency Distribution Plots for Concrete (Not Ground) Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

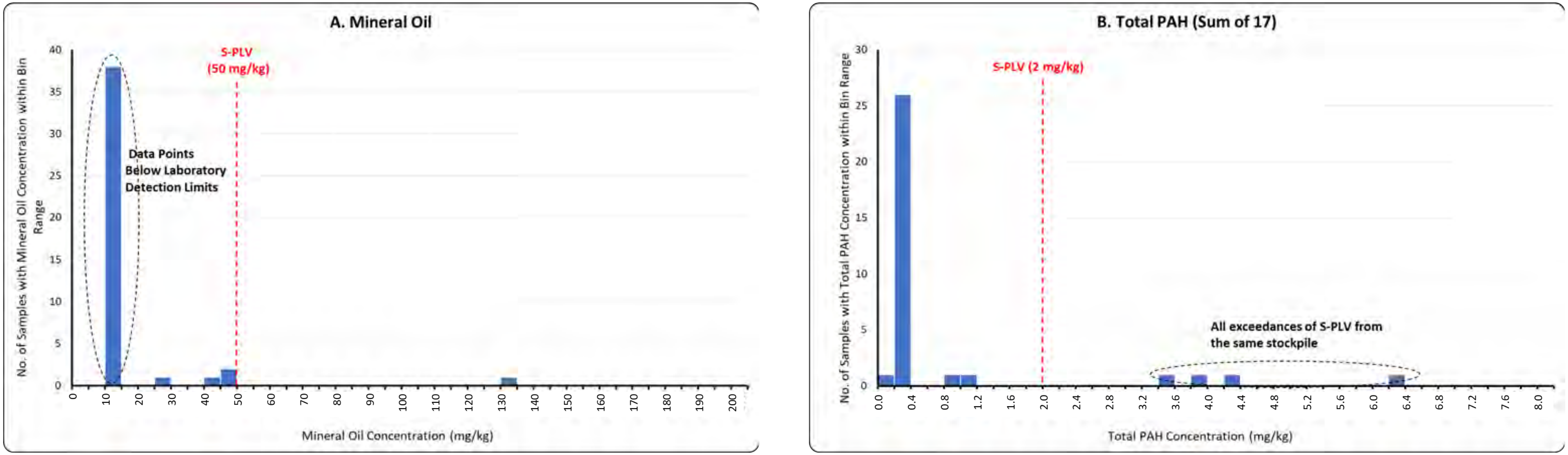

Figure D9 – Frequency Distribution Plots for Concrete (Not Ground) Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

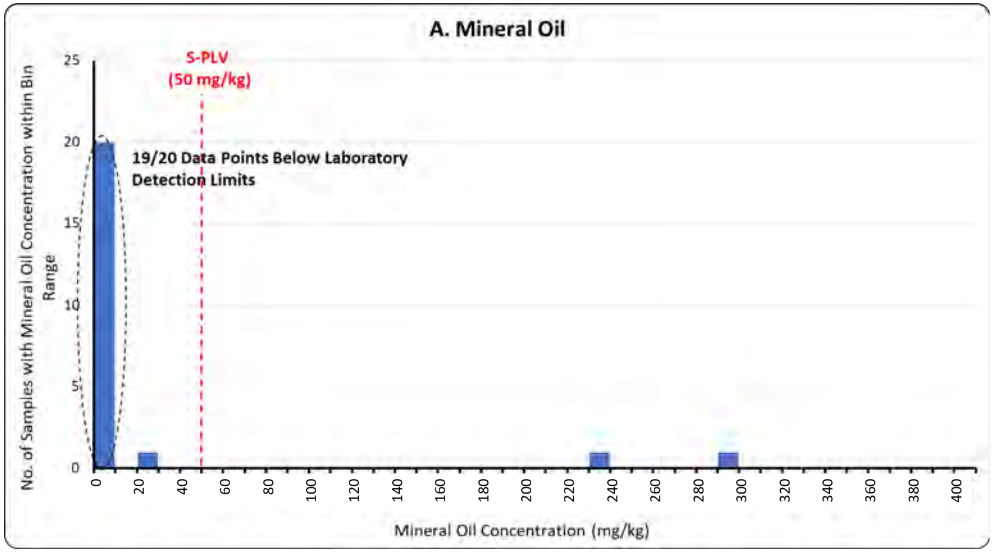

Figure D10 – Frequency Distribution Plots for Mixed Construction & Demolition Material Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

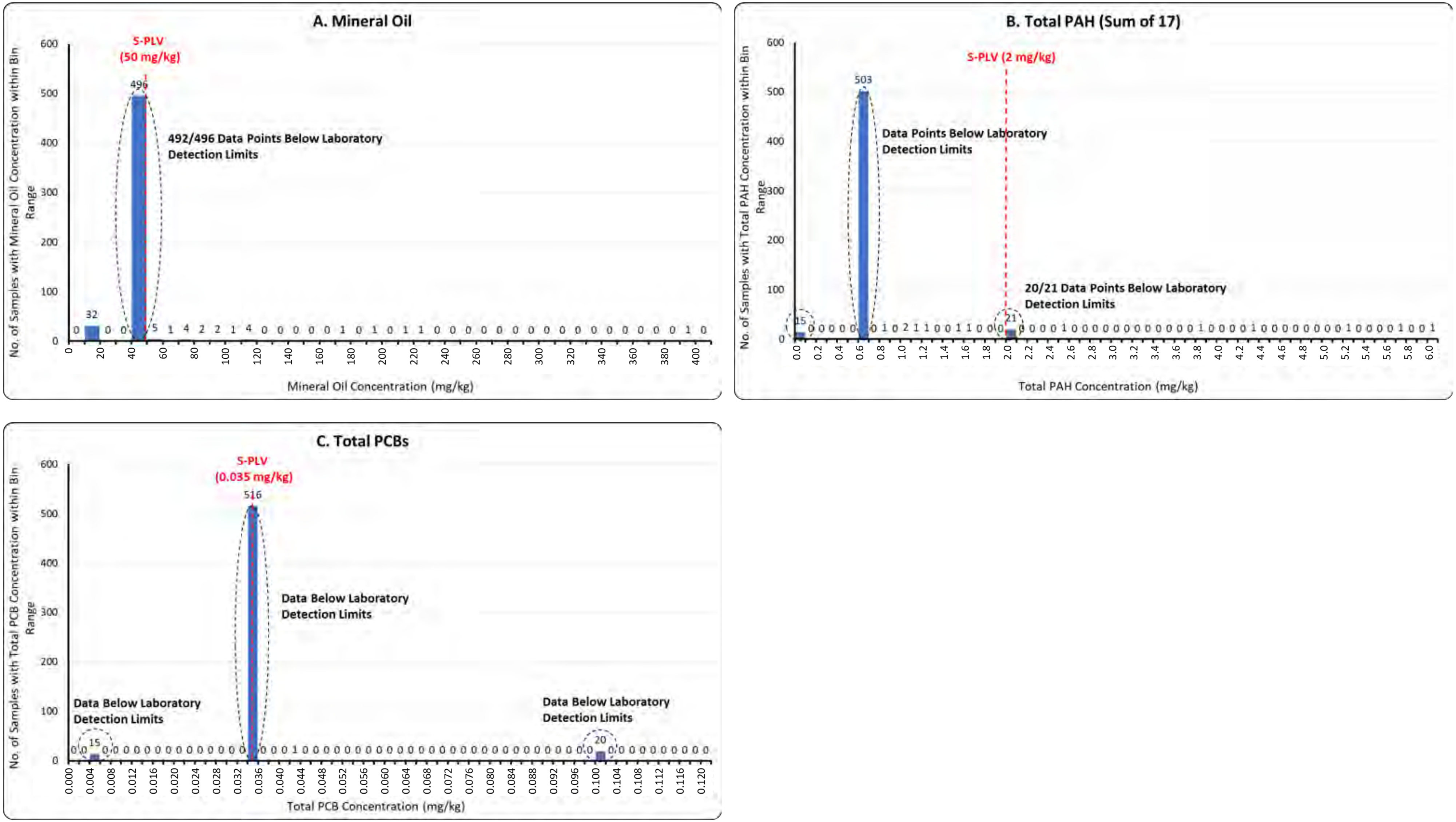

Figure D11 – Frequency Distribution Plots for Rock By Product Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

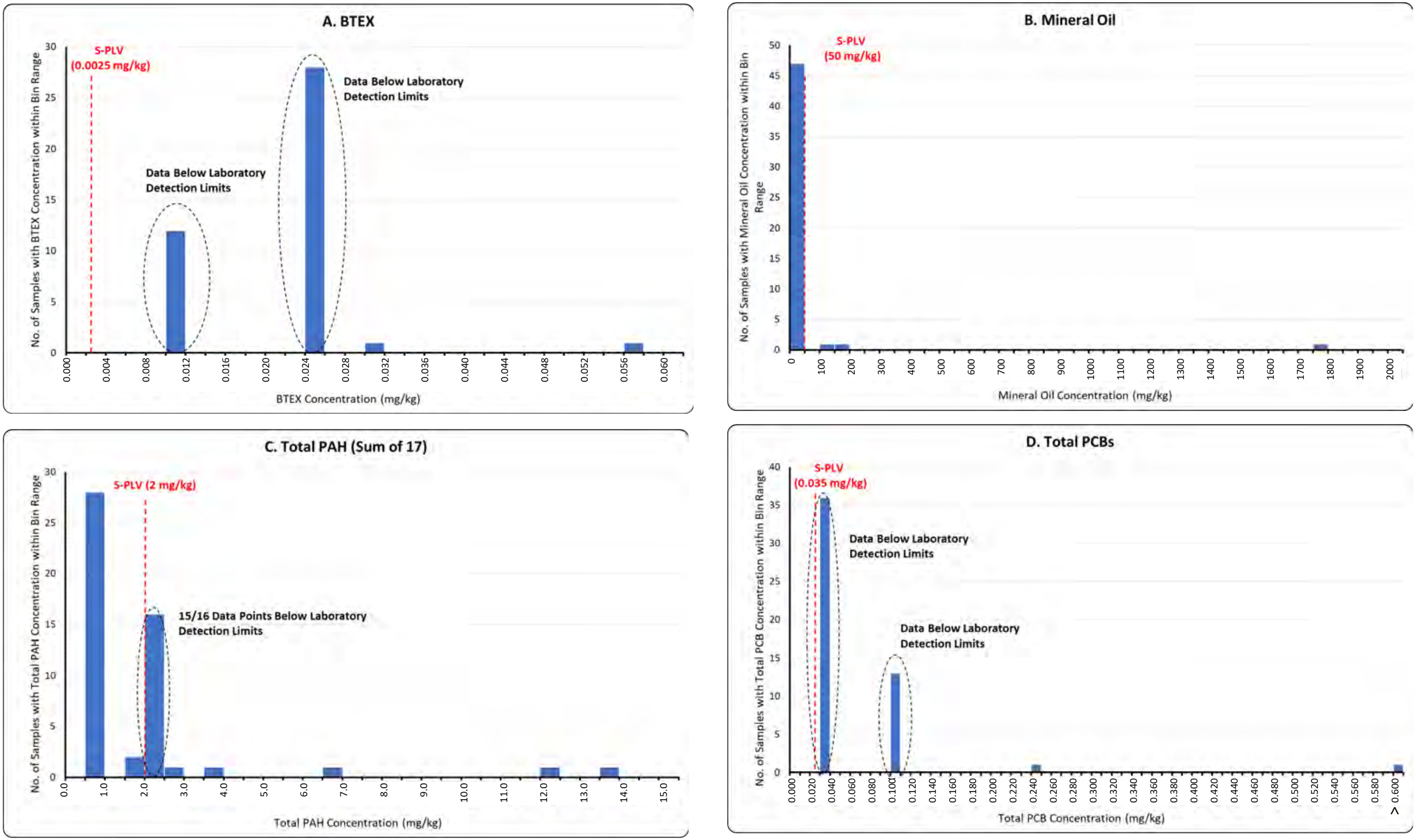

Figure D12 – Frequency Distribution Plots for Waste Stone Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

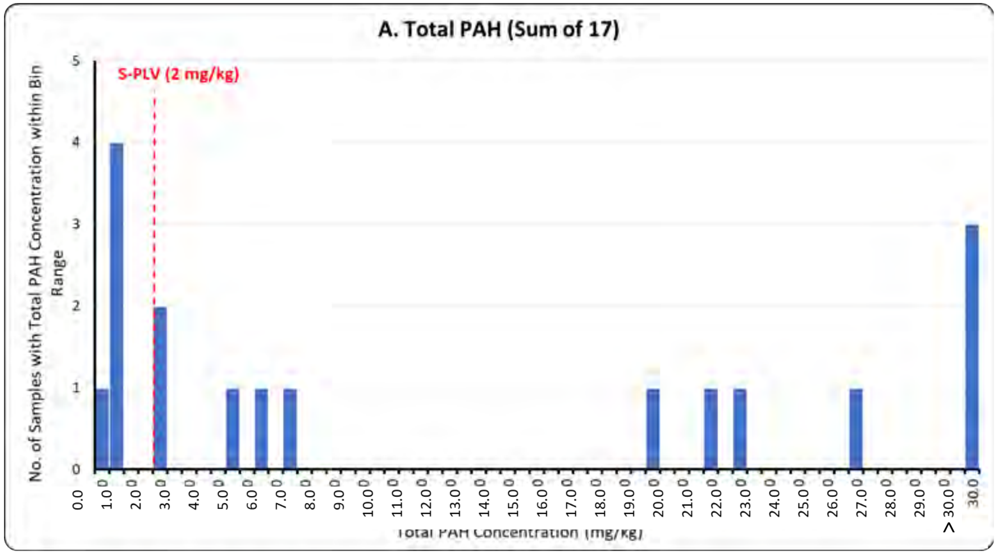

Figure D13 – Frequency Distribution Plots for Waste Soil and Aggregate Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

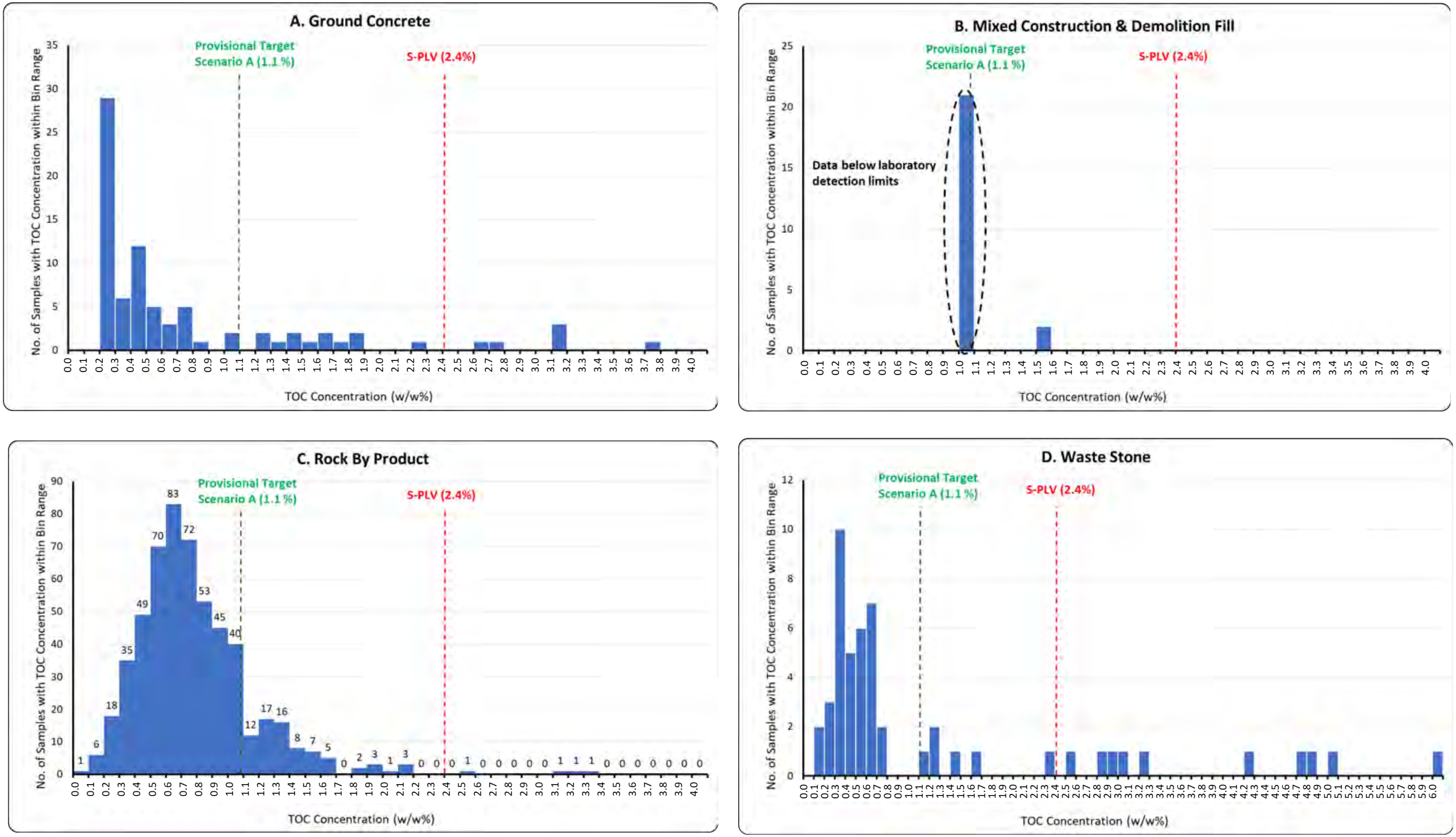

Figure D14a – Frequency Distribution Plots for TOC Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

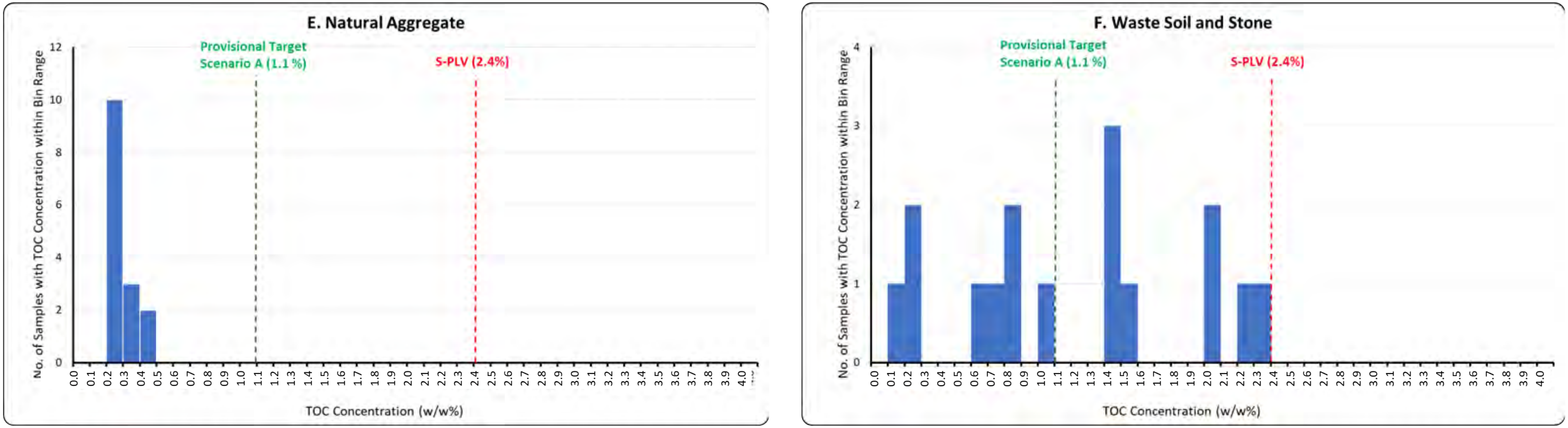

Figure D14b – Frequency Distribution Plots for TOC Data from Industry Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

A P P E N D I X

E

National Dataset Summary Statistics and Data Distribution Plots vs Pollutant Limit Values

Table E1: Concrete (Unwashed, Not Ground) Summary Statistics for 10:1 L/S Ratio Leachate Data for National Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
pH (pH units)	30	30	8.1	9.25	9.9	11.075	12.355	12.5	10.1	10
Total Dissolved Solids	30	30	53	1575	5350	13000	21000	22000	8030	4120
Chloride	30	26	*10*	18.25	26.5	62	400.5	450	92	40.1
Fluoride	30	30	0.83	1.8	2.05	2.4	3.755	3.9	2.21	2.08
Sulphate	30	30	20	94.75	240	622.5	15000	15000	2210	341
Calcium	30	30	170	330	685	2325	6965	7200	1660	851
Potassium	30	29	*5*	69.25	90.5	125	221	250	104	84.6
Aluminium	30	30	*0.17*	2.025	8.55	14	23.55	30	9.49	4.61
Arsenic	30	25	*0.002*	0.00225	0.00405	0.007725	0.02365	0.036	0.00685	0.00464
Barium	30	26	*0.05*	0.0825	0.15	0.3725	1.11	1.3	0.286	0.173
Cadmium	30	29	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	0.001	0.000807	0.000806
Chromium (Total)	30	27	*0.005*	0.068	0.13	0.215	0.441	0.6	0.163	0.092
Copper	30	24	*0.005*	0.0105	0.0215	0.09525	0.282	0.48	0.0775	0.0316
Mercury Low Level	30	4	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.00013	0.00015	0.000105	0.000104
Molybdenum	30	27	*0.002*	0.0165	0.066	0.4725	1.306	2.5	0.308	0.0706
Nickel	30	17	*0.005*	*0.005*	0.0092	0.01975	0.08155	0.13	0.023	0.0123
Lead	30	4	*0.005*	*0.005*	*0.005*	*0.005*	0.011535	0.015	0.00578	0.00548
Antimony	30	27	*0.005*	0.00815	0.016	0.024	0.1847	0.3	0.0361	0.0169
Selenium	30	27	*0.005*	0.00715	0.0155	0.05875	0.131	0.27	0.0426	0.021
Vanadium	30	25	*0.005*	0.0062	0.021	0.04575	0.11155	0.15	0.0339	0.019
Zinc	30	5	*0.025*	*0.025*	*0.025*	*0.025*	0.121	0.14	0.036	0.0301
Tin	30	4	*0.005*	*0.005*	*0.005*	*0.005*	0.006665	0.019	0.00561	0.00536
Dissolved Organic Carbon	30	30	*2.1*	4.5	14.5	55	130.85	200	37	15.9
Aliphatic TPH >C5-C6	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C6-C8	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.083	0.00373	0.00116
Aliphatic TPH >C8-C10	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.72	0.025	0.00125
Aliphatic TPH >C10-C12	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.63	0.022	0.00124
Aliphatic TPH >C12-C16	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	1.2	0.041	0.00127
Aliphatic TPH >C16-C21	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.78	0.027	0.00125
Aliphatic TPH >C21-C35	30	2	*0.001*	*0.001*	*0.001*	*0.001*	0.77045	6.6	0.268	0.00171
Aliphatic TPH >C35-C44	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	1.1	0.0376	0.00126
Total Aliphatic Hydrocarbons	30	2	*0.05*	*0.05*	*0.05*	*0.05*	0.7925	11	0.46	0.0669
Aromatic TPH >C5-C7	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C7-C8	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C8-C10	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.025	0.0018	0.00111
Aromatic TPH >C10-C12	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.36	0.013	0.00122
Aromatic TPH >C12-C16	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.36	0.013	0.00122
Aromatic TPH >C16-C21	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.001	0.001
Aromatic TPH >C21-C35	30	2	*0.001*	*0.001*	*0.001*	*0.001*	3.35545	17	0.771	0.00185
Aromatic TPH >C35-C44	30	1	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.096	0.00417	0.00116
Total Aromatic Hydrocarbons	30	2	*0.05*	*0.05*	*0.05*	*0.05*	3.3775	18	0.85	0.0714
Total Petroleum Hydrocarbons	30	2	*0.1*	*0.1*	*0.1*	*0.1*	4.17	29	1.31	0.14
Benzene	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Toluene	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Ethylbenzene	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
m & p-Xylene	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
o-Xylene	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Total Xylenes	18	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Naphthalene	30	6	*0.001*	*0.001*	*0.001*	*0.0135*	0.05055	0.48	0.0239	0.00303
Acenaphthylene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Fluorene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Phenanthrene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Anthracene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Fluoranthene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Pyrene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[a]anthracene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Chrysene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[b]fluoranthene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[k]fluoranthene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[a]pyrene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Indeno(1,2,3-c,d)Pyrene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Dibenz(a,h)Anthracene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[g,h,i]perylene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Of 16 PAH's	30	6	*0.02*	*0.02*	*0.02*	*0.02*	0.05055	0.48	0.0375	0.0238
PCB 28	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 52	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 90+101	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 118	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 153	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 138	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 180	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Total PCBs (7 congeners)	30	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Total Phenols	30	0	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	-	-

Values in grey and italics are below the laboratory limit of detection.

Table E2: Mixed Construction and Demolition Fill (Not Ground, Unwashed) Summary Statistics for 10:1 L/S Ratio Leachate Data for National Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
pH (pH units)	6	6	9.3	10.45	10.6	10.675	11.15	11.3	10.5	10.5
Total Dissolved Solids	6	6	730	1017.5	1100	1475	2875	3300	1470	1290
Chloride	6	5	*10*	12.25	13.5	26	47.25	53	22	18.1
Fluoride	6	6	1.4	2.125	2.25	2.525	2.825	2.9	2.25	2.2
Sulphate	6	6	100	160	165	222.5	240	240	178	171
Calcium	6	6	140	152.5	165	237.5	282.5	290	195	187
Potassium	6	6	*25*	41.5	48.5	75	91	94	56.5	51.4
Aluminium	6	6	*11*	15	23.5	28.25	31.25	32	22	20.4
Arsenic	6	4	*0.002*	0.0023	0.0037	0.00435	0.005	0.0052	0.0035	0.00327
Barium	6	5	*0.05*	0.056	0.083	0.1175	0.1875	0.21	0.1	0.087
Cadmium	6	0	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	-	-
Chromium (Total)	6	6	*0.011*	0.02875	0.041	0.072	0.095	0.1	0.05	0.0396
Copper	6	6	*0.015*	0.01625	0.035	0.0515	0.08275	0.093	0.0408	0.0321
Mercury Low Level	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.0001	0.0001	0.0001	0.0001
Molybdenum	6	6	*0.0059*	0.01225	0.02	0.0225	0.044	0.051	0.0217	0.0174
Nickel	6	2	*0.005*	*0.005*	0.0066	0.009475	0.012975	0.014	0.00785	0.00722
Lead	6	0	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	-	-
Antimony	6	6	*0.015*	0.017	0.017	0.0245	0.02925	0.03	0.0205	0.0198
Selenium	6	5	*0.005*	0.005125	0.00825	0.0125	0.037	0.045	0.0141	0.0098
Vanadium	6	6	*0.042*	0.04725	0.0535	0.06125	0.09075	0.1	0.0597	0.0571
Zinc	6	0	*0.025*	*0.025*	*0.025*	*0.025*	0.025	0.025	0.025	0.025
Tin	6	0	*0.005*	*0.005*	*0.005*	*0.005*	0.005	0.005	0.005	0.005
Dissolved Organic Carbon	6	6	*2.5*	2.65	3	3.2	3.8	4	3.05	3.01
Aliphatic TPH >C5-C6	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C6-C8	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C8-C10	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C10-C12	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C12-C16	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C16-C21	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C21-C35	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C35-C44	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Aliphatic Hydrocarbons	6	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Aromatic TPH >C5-C7	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C7-C8	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C8-C10	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C10-C12	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C12-C16	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C16-C21	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C21-C35	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C35-C44	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Aromatic Hydrocarbons	6	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Total Petroleum Hydrocarbons	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzene	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Toluene	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Ethylbenzene	6	1	*0.01*	*0.01*	*0.01*	*0.01*	0.02875	0.035	0.0142	0.0123
m & p-Xylene	6	1	*0.01*	*0.01*	*0.01*	*0.01*	*0.1*	0.13	0.03	0.0153
o-Xylene	6	1	*0.01*	*0.01*	*0.01*	*0.01*	0.031	0.038	0.0147	0.0125
Total Xylenes	5	1	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	0.01	0.01	0.01
Naphthalene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthylene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Fluorene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Phenanthrene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Anthracene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Fluoranthene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Pyrene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[a]anthracene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Chrysene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[b]fluoranthene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[k]fluoranthene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[a]pyrene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Indeno(1,2,3-c,d)Pyrene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Dibenz(a,h)Anthracene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[g,h,i]perylene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Of 16 PAH's	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
PCB 28	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 52	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 90+101	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 118	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 153	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 138	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 180	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Total PCBs (7 congeners)	6	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Total Phenols	6	0	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	-	-

Values in grey and italics are below the laboratory limit of detection.

Table E3: Virgin Aggregate and Quarry Rock (Not Ground, Unwashed) Summary Statistics for 10:1 L/S Ratio Leachate Data for National Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
pH (pH units)	5	5	8.7	8.7	10	10.5	11.14	11.3	9.84	9.79
Total Dissolved Solids	5	5	440	470	560	720	2544	3000	1040	758
Chloride	5	1	*10*	*10*	*10*	*10*	14.8	16	11.2	11
Fluoride	5	5	0.83	0.84	1.1	1.1	1.18	1.2	1.01	1
Sulphate	5	5	12	20	61	110	110	110	62.6	44.6
Calcium	5	5	49	50	83	86	87.6	88	71.2	68.8
Potassium	5	5	15	21	28	37	53	57	31.6	28.4
Aluminium	5	5	1.2	1.5	1.6	4.7	6.14	6.5	3.1	2.45
Arsenic	5	5	*0.0039*	0.0054	0.019	0.021	0.1002	0.12	0.0339	0.0159
Barium	5	3	*0.05*	*0.05*	0.13	0.88	1.056	1.1	0.442	0.199
Cadmium	5	0	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	*0.0008*	-	-
Chromium (Total)	5	0	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	-	-
Copper	5	2	*0.005*	*0.005*	*0.005*	0.0057	0.02274	0.027	0.00954	0.00719
Mercury Low Level	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	0.0001	0.0001	-	-
Molybdenum	5	5	*0.0036*	0.004	0.005	0.029	0.0322	0.033	0.0149	0.00928
Nickel	5	1	*0.005*	*0.005*	0.005	0.005	0.0098	0.011	0.0062	0.00585
Lead	5	1	*0.005*	*0.005*	*0.005*	*0.005*	*0.021*	*0.025*	0.009	0.0069
Antimony	5	2	*0.005*	*0.005*	*0.005*	0.0051	0.00526	0.0053	0.00508	0.00508
Selenium	5	1	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	0.005	0.005	0.005
Vanadium	5	5	*0.0051*	0.0063	0.016	0.016	0.0168	0.017	0.0121	0.0107
Zinc	5	1	*0.025*	*0.025*	*0.025*	*0.025*	0.0546	0.062	0.0324	0.03
Tin	5	0	*0.005*	*0.005*	*0.005*	*0.005*	0.005	0.005	-	-
Dissolved Organic Carbon	5	5	*2.3*	3	3.2	3.2	19.04	23	6.94	4.39
Aliphatic TPH >C5-C6	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C6-C8	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C8-C10	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C10-C12	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C12-C16	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C16-C21	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C21-C35	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aliphatic TPH >C35-C44	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Aliphatic Hydrocarbons	5	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Aromatic TPH >C5-C7	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C7-C8	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C8-C10	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C10-C12	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C12-C16	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C16-C21	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C21-C35	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Aromatic TPH >C35-C44	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Aromatic Hydrocarbons	5	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Total Petroleum Hydrocarbons	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzene	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Toluene	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Ethylbenzene	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
m & p-Xylene	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
o-Xylene	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Total Xylenes	4	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Naphthalene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthylene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Fluorene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Phenanthrene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Anthracene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Fluoranthene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Pyrene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[a]anthracene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Chrysene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[b]fluoranthene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[k]fluoranthene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[a]pyrene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Indeno(1,2,3-c,d)Pyrene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Dibenz(a,h)Anthracene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Benzo[g,h,i]perylene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Total Of 16 PAH's	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
PCB 28	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 52	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 90+101	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 118	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 153	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 138	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
PCB 180	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Total PCBs (7 congeners)	5	0	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	*0.0001*	-	-
Total Phenols	5	0	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	-	-

Values in grey and italics are below the laboratory limit of detection.

Table E4: Concrete (Unwashed, Unground) Summary Statistics for Total Data for National Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Moisture (%)	34	34	0.58	2.025	3.55	5.575	7.755	20	4.28	3.3
pH (pH Units)	30	30	8.8	10.375	11.15	11.8	>12	>12	10.8	10.8
Chloride (Water Soluble) (g/l)	30	25	*0.01*	0.015	0.0205	0.028	0.03495	0.048	0.0214	0.0196
Fluoride (Extractable)	30	30	0.26	0.38	0.42	0.495	1.03	1.3	0.489	0.448
Aluminium (Total)	30	30	2700	4100	4900	6850	12550	13000	5960	5350
Calcium (Total)	30	30	14000	44250	80500	117500	150000	170000	83100	69200
Potassium (Total)	30	30	150	445	565	1037.5	1830	2200	769	617
Sulphate (Total)	30	30	110	2625	3500	5300	8030	8400	3840	2820
Antimony	30	1	*2*	*2*	*2*	*2*	*2*	3.9	2.06	2.05
Arsenic	34	34	1.6	2.225	5.25	7.225	14	32	5.98	4.49
Barium	34	34	20	25	32	51.25	220	230	54.6	40.4
Cadmium	34	22	*0.1*	*0.1*	0.16	0.3825	0.6245	1.1	0.262	0.199
Chromium	30	30	6.4	8.55	11.5	14	22.55	26	12.7	11.8
Copper	34	34	4.4	8.05	12	19.25	25	27	13.6	11.9
Lead	34	34	3	7	13	27.5	106.85	340	32.1	15.3
Mercury	30	8	*0.05*	*0.05*	*0.05*	0.065	0.15	0.18	0.0697	0.063
Mercury Low Level	30	7	*0.05*	*0.05*	*0.05*	*0.05*	0.1665	0.22	0.07	0.0616
Molybdenum	30	14	*0.5*	*0.5*	*0.5*	0.7	1.755	4.3	0.787	0.659
Nickel	34	34	5.2	7.6	10.5	15	20.35	23	11.9	10.9
Selenium	34	18	0.25	0.25	0.25	0.53	0.807	0.85	0.392	0.351
Vanadium	34	34	7	10.25	13	17	62	66	17.8	14.7
Tin	30	6	*2*	*2*	*2*	*2*	14.4	33	3.98	2.6
Zinc	34	34	16	26.25	42	75.75	273.5	290	70.6	48.2
Chromium (Hexavalent)	30	2	*0.5*	*0.5*	*0.5*	*0.5*	0.5055	1.1	0.52	0.514
Aliphatic TPH >C5-C6	30	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C6-C8	30	1	*1*	*1*	*1*	*1*	*1*	8.8	1.26	1.08
Aliphatic TPH >C8-C10	30	2	*1*	*1*	*1*	*1*	2.925	76	3.62	1.21
Aliphatic TPH >C10-C12	30	4	*1*	*1*	*1*	*1*	15.2	67	4.35	1.47
Aliphatic TPH >C12-C16	30	4	*1*	*1*	*1*	*1*	55.3	130	9.1	1.64
Aliphatic TPH >C16-C21	30	4	*1*	*1*	*1*	*1*	53.3	290	14.3	1.67
Aliphatic TPH >C21-C35	30	7	*1*	*1*	*1*	*1*	200.5	700	48.6	3.18
Aliphatic TPH >C35-C44	30	2	*1*	*1*	*1*	*1*	7.05	120	5.33	1.27
Total Aliphatic Hydrocarbons	30	7	*5*	*5*	*5*	*5*	392	1200	84.3	12
Aromatic TPH >C5-C7	30	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C7-C8	30	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C8-C10	30	1	*1*	*1*	*1*	*1*	*1*	2.6	1.05	1.03
Aromatic TPH >C10-C12	30	1	*1*	*1*	*1*	*1*	*1*	38	2.23	1.13
Aromatic TPH >C12-C16	30	2	*1*	*1*	*1*	*1*	3.805	38	2.4	1.2
Aromatic TPH >C16-C21	30	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C21-C35	30	6	*1*	*1*	*1*	*1*	647.5	1800	110	2.89
Aromatic TPH >C35-C44	30	2	*1*	*1*	*1*	*1*	5.95	23	-	-
Total Aromatic Hydrocarbons	30	7	*5*	*5*	*5*	*5*	658.5	1900	117	10.6
Total Petroleum Hydrocarbons	30	7	*10*	*10*	*10*	*10*	864.5	3000	199	24.6
Total BTEX	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Benzene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Toluene	30	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	0.001	0.001
Ethylbenzene	30	2	*0.001*	*0.001*	*0.001*	*0.001*	0.001055	0.0015	0.00102	0.00102
m & p-Xylene	30	2	*0.001*	*0.001*	*0.001*	*0.001*	0.002155	0.0051	0.00121	0.0011
o-Xylene	30	2	*0.001*	*0.001*	*0.001*	*0.001*	0.001165	0.0022	0.00105	0.00104
Acenaphthene	30	2	*0.1*	*0.1*	*0.1*	*0.1*	0.1275	0.17	0.104	0.103
Acenaphthylene	30	2	*0.1*	*0.1*	*0.1*	*0.1*	0.287	0.91	0.138	0.113
Anthracene	30	3	*0.1*	*0.1*	*0.1*	*0.1*	0.201	0.21	0.11	0.107
Benzo[a]anthracene	30	2	*0.1*	*0.1*	*0.1*	*0.1*	0.155	0.26	0.109	0.106
Benzo[a]pyrene	30	2	*0.1*	*0.1*	*0.1*	*0.1*	0.5675	1.3	0.168	0.117
Benzo[b]fluoranthene	30	2	*0.1*	*0.1*	*0.1*	*0.1*	0.199	0.36	0.115	0.108
Benzo[g,h,i]perylene	30	7	*0.1*	*0.1*	*0.1*	*0.1*	1.377	1.9	0.294	0.161
Benzo[k]fluoranthene	30	7	*0.1*	*0.1*	*0.1*	*0.1*	1.084	1.4	0.245	0.152
Chrysene	30	3	*0.1*	*0.1*	*0.1*	*0.1*	1.0635	1.7	0.214	0.127
Dibenz(a,h)Anthracene	30	3	*0.1*	*0.1*	*0.1*	*0.1*	0.7155	1.2	0.176	0.123
Fluoranthene	30	12	*0.1*	*0.1*	*0.1*	0.575	1.85	2.9	0.461	0.225
Fluorene	30	3	*0.1*	*0.1*	*0.1*	*0.1*	0.7165	1.3	0.179	0.123
Indeno(1,2,3-c,d)Pyrene	30	3	*0.1*	*0.1*	*0.1*	*0.1*	2.445	3.8	0.373	0.139
Naphthalene	30	1	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	2.8	0.19	0.112
Phenanthrene	30	2	*0.1*	*0.1*	*0.1*	*0.1*	0.3035	0.91	0.139	0.113
Pyrene	30	10	*0.1*	*0.1*	*0.1*	0.3125	1.1335	2.8	0.332	0.179
Total Of 16 PAH's	30	4	*2*	*2*	*2*	*2*	10.915	22	3.28	2.44
PCB 28	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 52	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 90+101	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 118	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 153	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 138	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 180	30	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Total PCBs (7 Congeners)	30	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Resorcinol	30	1	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	0.067	0.0216	0.0208
Phenol	30	2	*0.02*	*0.02*	*0.02*	*0.02*	0.0442	0.073	0.0232	0.0217
Cresols	30	1	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	0.061	0.0214	0.0208
Xylenols	30	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
1-Naphthol	30	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Trimethylphenols	30	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Total Phenols	30	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-

Values in grey and italics are below the laboratory limit of detectior

Table E5: Mixed Construction and Demolition Fill (Unwashed, Unground) Summary Statistics for Total Data for National Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Moisture (%)	6	6	2.6	3.25	4.65	5.825	7.25	7.7	4.77	4.43
pH (pH Units)	6	6	8	8.1	8.15	8.425	8.65	8.7	8.27	8.26
Chloride (Water Soluble) (g/l)	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Fluoride (Extractable)	6	6	0.74	0.81	0.85	0.905	0.935	0.94	0.85	0.847
Aluminium (Total)	6	6	880	2825	3200	4475	4875	4900	3300	2890
Calcium (Total)	6	6	11000	30000	33500	34000	37750	39000	30000	27900
Potassium (Total)	6	6	130	390	520	627.5	725	750	488	428
Sulphate (Total)	6	6	980	1700	2400	2800	3050	3100	2210	2060
Antimony	6	0	*2*	*2*	*2*	*2*	*2*	*2*	-	-
Arsenic	6	5	*0.5*	0.55	0.9	1.475	1.9	2	1.07	0.922
Barium	6	6	5	17	21	25.75	26.75	27	19.5	17.1
Cadmium	6	1	*0.1*	*0.1*	*0.1*	*0.1*	0.1075	0.11	0.102	0.102
Chromium	6	6	1.5	4.85	5.5	6.45	8.7	9.4	5.55	4.87
Copper	6	6	1.9	6.7	8.95	11.275	12.75	13	8.47	7.23
Lead	6	6	1.3	7.65	8.7	9.45	19.675	23	9.78	7.37
Mercury	6	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Mercury Low Level	6	0	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	-	-
Molybdenum	6	3	*0.5*	*0.5*	*0.5*	0.575	0.675	0.7	0.55	0.545
Nickel	6	6	1.4	4.6	6.25	7.075	12.3	14	6.55	5.33
Selenium	6	1	*0.25*	*0.25*	*0.25*	*0.25*	0.2875	0.3	0.258	0.258
Vanadium	6	6	1.5	4.725	6.4	7.25	10.1	11	6.17	5.27
Tin	6	2	*2*	*2*	*2*	2.975	3.45	3.5	2.47	2.39
Zinc	6	6	6.6	49	62.5	70	92.75	100	58.1	45.1
Chromium (Hexavalent)	6	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Aliphatic TPH >C5-C6	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C6-C8	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C8-C10	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C10-C12	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C12-C16	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C16-C21	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C21-C35	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C35-C44	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Total Aliphatic Hydrocarbons	6	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Aromatic TPH >C5-C7	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C7-C8	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C8-C10	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C10-C12	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C12-C16	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C16-C21	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C21-C35	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C35-C44	6	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Total Aromatic Hydrocarbons	6	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Total Petroleum Hydrocarbons	6	0	*10*	*10*	*10*	*10*	*10*	*10*	-	-
Total BTEX	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Benzene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Toluene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Ethylbenzene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
m & p-Xylene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
o-Xylene	6	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Acenaphthylene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Anthracene	6	1	*0.1*	*0.1*	*0.1*	*0.1*	0.6775	0.87	0.228	0.143
Benzo[a]anthracene	6	1	*0.1*	*0.1*	*0.1*	*0.1*	1.375	1.8	0.383	0.162
Benzo[a]pyrene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[b]fluoranthene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[g,h,i]perylene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[k]fluoranthene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Chrysene	6	1	*0.1*	*0.1*	*0.1*	*0.1*	1.3	1.7	0.367	0.16
Dibenz(a,h)Anthracene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Fluoranthene	6	1	*0.1*	*0.1*	*0.1*	*0.1*	3.55	4.7	0.867	0.19
Fluorene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Indeno(1,2,3-c,d)Pyrene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Naphthalene	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Phenanthrene	6	1	*0.1*	*0.1*	*0.1*	*0.1*	2.425	3.2	0.617	0.178
Pyrene	6	1	*0.1*	*0.1*	*0.1*	*0.1*	3.025	4	0.75	0.185
Total Of 16 PAH's	6	1	*2*	*2*	*2*	*2*	12.5	16	4.33	2.83
PCB 28	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 52	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 90+101	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 118	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 153	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 138	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 180	6	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Total PCBs (7 Congeners)	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Resorcinol	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Phenol	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Cresols	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Xylenols	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
1-Naphthol	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Trimethylphenols	6	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Total Phenols	6	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-

Values in grey and italics are below the laboratory limit of detectior

Table E6: Virgin Aggregate and Quarry Stone (Unwashed, Unground) Summary Statistics for Total Data for National Dataset

Analyte	Count	Detects > LoD	Min (mg/kg)	25th Percentile (mg/kg)	50th Percentile (mg/kg)	75th Percentile (mg/kg)	95th Percentile (mg/kg)	Max (mg/kg)	Mean (mg/kg)	Geomean (mg/kg)
Moisture (%)	5	5	0.37	0.62	0.64	2.1	4.18	4.7	1.69	1.08
pH (pH Units)	5	5	8.5	8.7	9.1	9.2	9.52	9.6	9.02	9.01
Chloride (Water Soluble) (g/l)	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Fluoride (Extractable)	5	5	0.19	0.19	0.28	0.34	0.436	0.46	0.292	0.275
Aluminium (Total)	5	5	2300	2700	3000	3700	9540	11000	4540	3770
Calcium (Total)	5	5	5900	8000	11000	13000	28200	32000	14000	11700
Potassium (Total)	5	5	290	540	560	650	874	930	594	556
Sulphate (Total)	5	5	170	470	860	970	2994	3500	1190	747
Antimony	5	0	*2*	*2*	*2*	*2*	*2*	*2*	-	-
Arsenic	5	5	0.8	2	6.1	6.3	9.26	10	5.04	3.61
Barium	5	5	12	17	44	95	163	180	69.6	43.4
Cadmium	5	1	*0.1*	*0.1*	*0.1*	*0.1*	0.124	0.13	0.106	0.105
Chromium	5	5	2	2.5	2.7	3.2	17.44	21	6.28	3.9
Copper	5	5	1.8	2.5	3.9	8.7	19.34	22	7.78	5.07
Lead	5	5	1.5	2.4	3.9	5.9	121.18	150	32.7	6.59
Mercury	5	1	*0.05*	*0.05*	*0.05*	*0.05*	*0.122*	*0.14*	-	-
Mercury Low Level	5	1	*0.05*	*0.05*	*0.05*	*0.05*	*0.122*	*0.14*	-	-
Molybdenum	5	1	*0.5*	*0.5*	*0.5*	0.5	0.82	0.9	0.58	0.562
Nickel	5	5	2.7	3.9	7.6	12	16	17	8.64	6.96
Selenium	5	5	0.25	0.26	0.3	0.78	0.844	0.86	0.49	0.42
Vanadium	5	4	1.4	1.7	2.6	2.8	49.36	61	13.9	4.03
Tin	5	0	*2*	*2*	*2*	*2*	*2*	*2*	-	-
Zinc	5	5	7.6	11	11	17	203.4	250	59.3	20.8
Chromium (Hexavalent)	5	0	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	-	-
Aliphatic TPH >C5-C6	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C6-C8	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C8-C10	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C10-C12	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C12-C16	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C16-C21	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C21-C35	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aliphatic TPH >C35-C44	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Total Aliphatic Hydrocarbons	5	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Aromatic TPH >C5-C7	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C7-C8	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C8-C10	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C10-C12	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C12-C16	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C16-C21	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C21-C35	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Aromatic TPH >C35-C44	5	0	*1*	*1*	*1*	*1*	*1*	*1*	-	-
Total Aromatic Hydrocarbons	5	0	*5*	*5*	*5*	*5*	*5*	*5*	-	-
Total Petroleum Hydrocarbons	5	0	*10*	*10*	*10*	*10*	*10*	*10*	-	-
Total BTEX	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Benzene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Toluene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Ethylbenzene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
m & p-Xylene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
o-Xylene	5	0	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	-	-
Acenaphthene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Acenaphthylene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Anthracene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[a]anthracene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[a]pyrene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[b]fluoranthene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[g,h,i]perylene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Benzo[k]fluoranthene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Chrysene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Dibenz(a,h)Anthracene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Fluoranthene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Fluorene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Indeno(1,2,3-c,d)Pyrene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Naphthalene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Phenanthrene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Pyrene	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Total Of 16 PAH's	5	0	*2*	*2*	*2*	*2*	*2*	*2*	-	-
PCB 28	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 52	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 90+101	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 118	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 153	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 138	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
PCB 180	5	0	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	-	-
Total PCBs (7 Congeners)	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-
Resorcinol	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Phenol	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Cresols	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Xylenols	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
1-Naphthol	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Trimethylphenols	5	0	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	-	-
Total Phenols	5	0	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	-	-

Values in grey and italics are below the laboratory limit of detectior

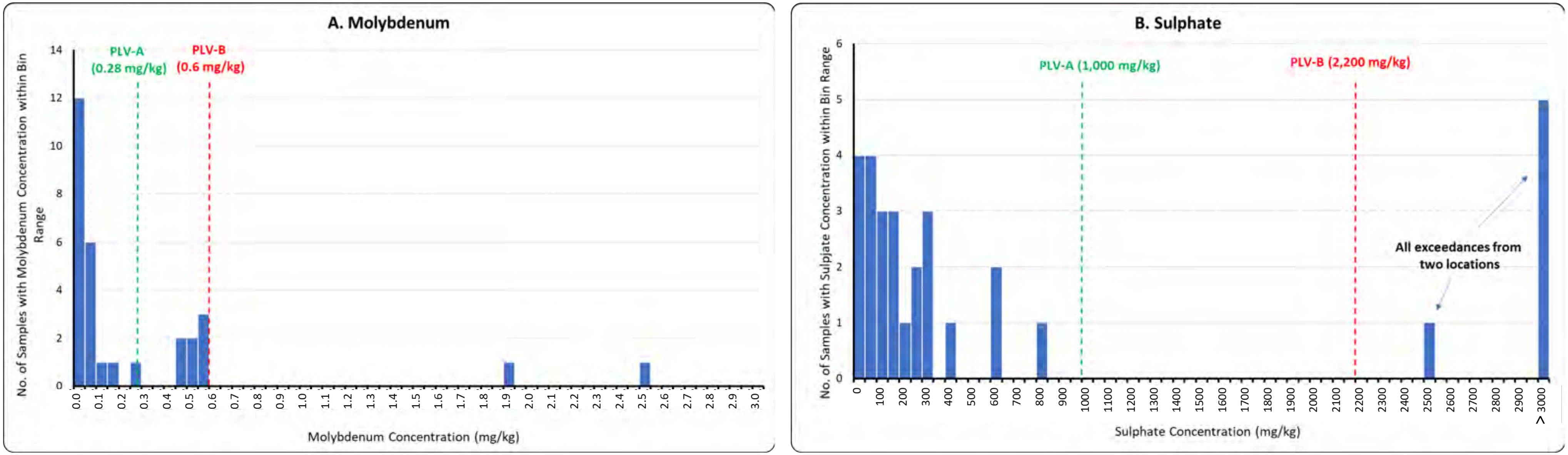

Figure E1 – Frequency Distribution Plots for Concrete (Not Ground) Data from National Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

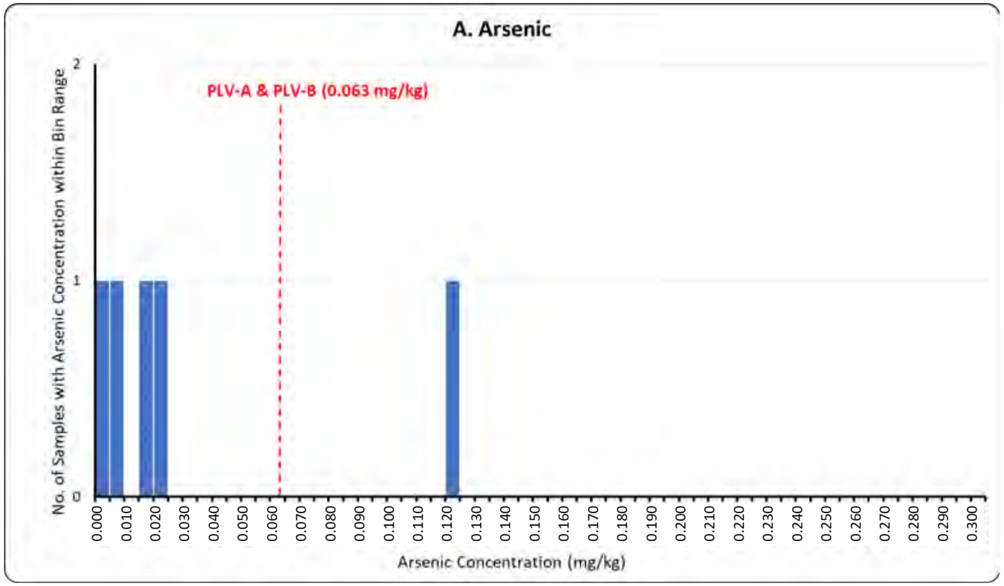

Figure E2 – Frequency Distribution Plots for Virgin Aggregate and Quarry Stone Data from National Dataset vs Leachate PLV

Note: PLV-A, PLV-B and contaminant values are 10:1 L/S ratio leachate concentrations

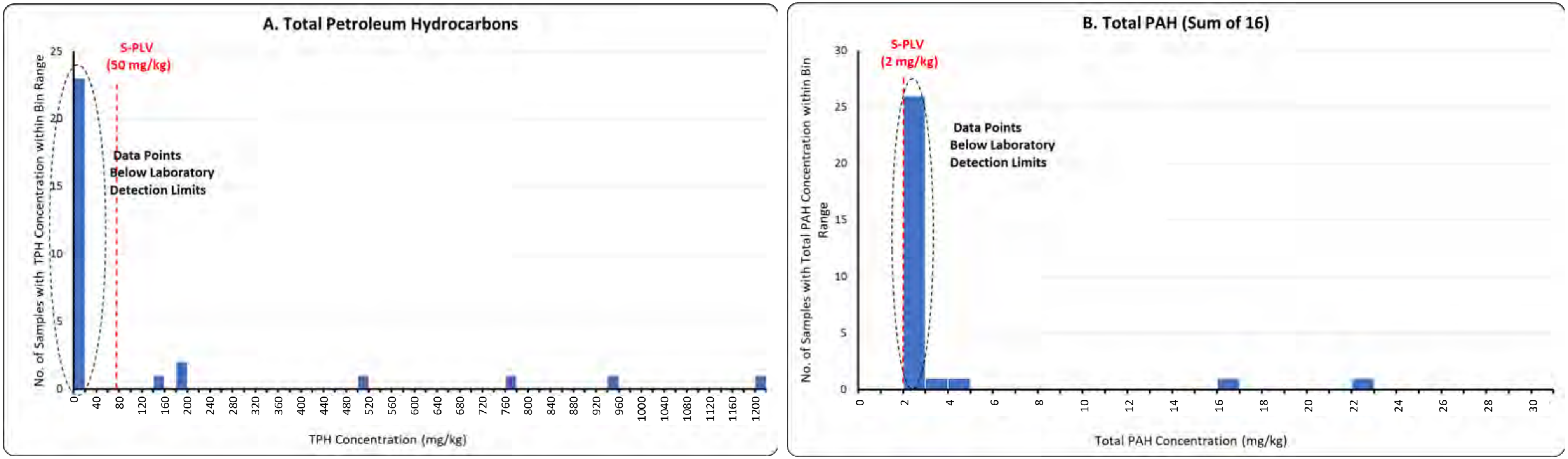

Figure E3 – Frequency Distribution Plots for Concrete (Not Ground) Data from National Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

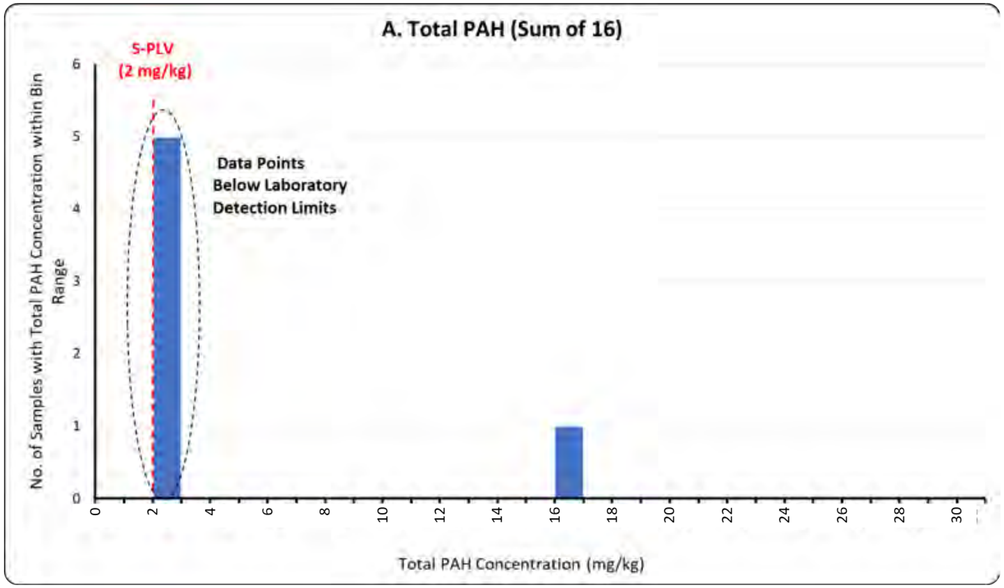

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Figure E4 – Frequency Distribution Plots for Mixed Construction & Demolition Fill Data from National Dataset vs Solid PLV

Note: S-PLV and contaminant values are total solid concentrations

A P P E N D I X

F

Laboratory Trials on the Leachability of Determinands from Recycled Aggregate

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End-of-Waste Technical Information

Laboratory Trials on the Leachability of Determinands from Recycled Aggregate

Prepared for

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Final

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LIMITATION

Geosyntec Consultants Ltd (Geosyntec) has prepared this report for the sole use of the Environmental Protection Agency (Ireland) in accordance with the Agreement under which our services were performed. No other warranty, express or implied, is made as to the professional advice included in this report or any other services provided by us. This report may not be relied upon by any other party without the prior and express written agreement of Geosyntec, which will not be unreasonably withheld.

The conclusions and recommendations contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested. Information obtained from third parties has not been independently verified by Geosyntec, unless otherwise stated in the report.

Where assessments of works or costs required to reduce or mitigate any environmental liability identified in this report are made, such assessments are based upon the information available at the time and may be subject to further investigations or information which may become available. It is therefore possible that cost estimates, where provided, may vary outside stated ranges. Where assessments of works or costs necessary to achieve compliance have been made these are based upon measures which, in Geosyntec's experience could normally be negotiated with the relevant authorities under present legislation and enforcement practice, assuming a pro-active and reasonable approach by site management.

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TABLES

APPENDICES

1 GENERAL INTRODUCTION

1.1 Introduction, Scope and Objectives

Geosyntec Consultants, Ltd (Geosyntec) was commissioned by the Environment Protection Agency (Ireland) (EPA) to provide technical support for the development of proposed End-of-Waste Pollutant Limit Values (PLVs) for granular recycled aggregate products (Recycled Aggregate). As part of this work Geosyntec have coordinated laboratory trials to evaluate the leachability of potential determinands from Recycled Aggregate. This work has been undertaken in line with our proposal reference GCU0146045-1/GB/GW dated 8th November 2022, and the contract for works dated 25th November 2022.

The overall aim of the study was to assess how the leachability of determinands from Recycled Aggregate can be affected by holding/stockpiling times before use, and also by laboratory sample preparation prior to analysis. The trials were designed to enable:

- A comparison between the leachability of determinands from "as received" (non-crushed) samples and leachability of determinands from samples that undergo standard pre-analysis laboratory preparation (being crushed or ground) prior to testing. The purpose of this trial was to determine whether laboratory preparation methods involving the crushing of Recycled Aggregate samples (or even on-site crushing of materials prior to shipping to the laboratory) increases the leachable determinand concentrations (compared with non-crushed samples).
- An assessment of the effect of holding/stockpiling times between aggregate generation and use on resulting determinand leachate concentrations. It is noted from scientific literature that stockpiling for a period of time prior to use tends to lead to a reduction in leachate concentrations, but few examples have so far been presented on this. This assessment aims to provide insight into the effects of the duration of stockpiling on leachate concentrations from Recycled Aggregate (in particularly concrete Recycled Aggregate) currently used within the construction industry. Such reduction in leachate concentrations may be attributed to weathering processes and in particular the carbonation process.

A purpose of the trials was also to identify recommendations for the laboratory analysis and stockpiling of Recycled Aggregate. Where appropriate these recommendations have been incorporated into the main body of the End-of-Waste Technical Information "Development of Pollutant Limit Values for Recycled Aggregate Products" report.

1.2 Limitations to this Report

This report and its recommendations are based on the analysis of six samples obtained from Recycled Aggregate producers in Ireland. The composition of a Recycled Aggregate is clearly dependent on the source of input materials, which will vary over time and with each producer. With this in mind, the determinand composition of the tested samples should not be taken to be indicative of all Recycled Aggregate products. Appropriate routine testing that should be regularly undertaken to characterise a Recycled Aggregate is detailed in the main body of the End-of-Waste Technical Information "Development of Pollutant Limit Values for Recycled Aggregate Products" report.

2 METHODS

2.1 Sample Collection

Geosyntec collected six composite Recycled Aggregate samples from three different waste producer sites in the wider Dublin area on 22nd November 2022. The samples were each around 4 kg to 5 kg in mass. Details of samples taken are provided in Table A below and a photographic record of the stockpiles and samples taken is provided in Appendix I. Prior to attending the sites, waste producers were contacted to gain information on potential stockpiles to sample. This information is collated in questionnaires included in Appendix II.

Table A Recycled Aggregate Sample Details

Site	Aggregate Sample	Material	Aggregate Size	Age	Sampling Notes	Description
A	A1	Concrete Aggregate	6F2 (75 mm and down)	c. 3 weeks	Sub sampled from 4 locations and homogenised. Pieces >35 mm removed.	Brown slightly clayey, slightly silty gravelly medium to coarse sand. c.15 % 5 mm to 35 mm concrete fragments c. 4% subangular pebbles of dark grey crystalline rock (limestone or shale) <1% (very rare) plastic
B	B1	Natural Aggregate	10 mm	< 1 week	Sub sampled from 4 locations and homogenised.	Multicoloured medium to coarse sandstone, quartz, limestone and fine crystalline black gravel <1% red brick fragments, rare rootlets, concrete fragments
	B2	Natural Aggregate	10 mm	c. 1 month	Sub sampled from 4 locations and homogenised.	
C	C1	Concrete Aggregate	<30 mm	< 3 days	Sub sampled from 3 locations and homogenised.	Multicoloured silty sandy sandstone, black fine-grained rock and concrete gravel. Sand is fine to coarse. Sample is 40% fines and 60% gravel < 1 % rootlets c. 1 % brick 5 to 30 mm in size Concrete makes up c. 40% of gravel
	C2	Concrete Aggregate	<30 mm	c. 1 week	Sub sampled from 3 locations and homogenised.	Multicoloured gravelly fine to coarse sand. Gravel is sandstone, black fine-grained rock and concrete Sample is 60% fines and 40% gravel < 1 % rootlets c. 1 % brick 5 to 30 mm in size Concrete makes up c. 40% of gravel

Site	Aggregate Sample	Material	Aggregate Size	Age	Sampling Notes	Description
	C3	Concrete Aggregate	<30 mm	c. 6 months	Sub sampled from 3 locations and homogenised.	Brown gravelly coarse sand. Gravel is subrounded stone and concrete. Sample is 80% fines and 20% gravel. 5% of the sample is concrete gravel. <<1% brick

The age of the Recycled Aggregate in Table A is the time the aggregate had spent outdoors in a stockpile post-crushing, and before it was sampled by Geosyntec.

The day after sampling, the aggregate samples were sent under chain of custody in cooler boxes to Element Laboratory, Deeside UK, a UKAS accredited laboratory.

2.2 Sample Preparation and Experimental Setup

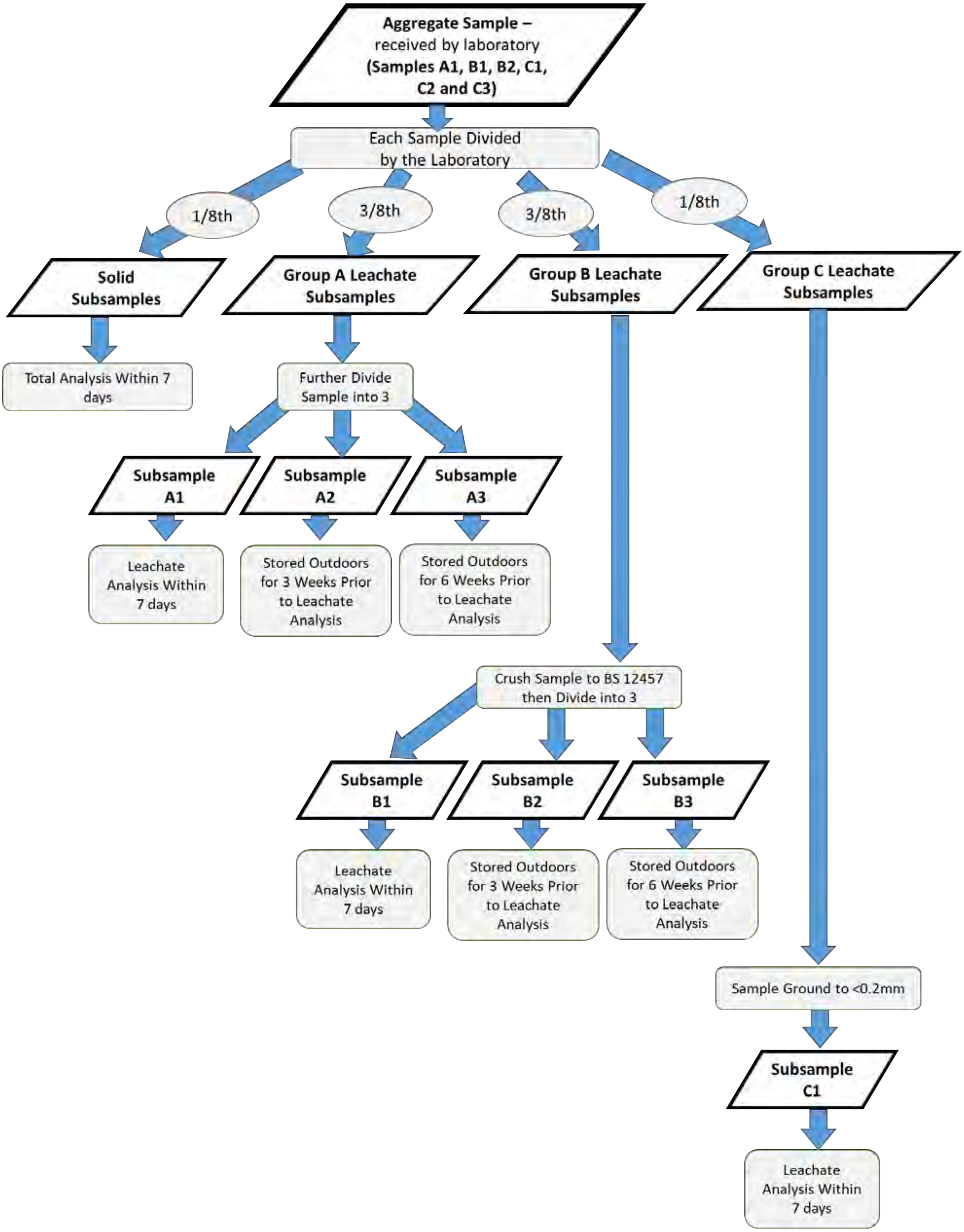
The samples were received by Element on 24th November 2022. On 29th November 2022 the laboratory divided each of the six samples (A1, B1, B2, C1, C2 and C3) into eight sub-samples as detailed below and in the flow chart on the following page (Figure A) prior to analysis, with each sub sample group undergoing a different preparation.

The sub-division of samples detailed in Figure A was as follows:

- Solid Sub-samples: For each aggregate sample total concentration analysis was undertaken on a single subsample, allowing a comparison to be made between the leachate test results and the total chemical composition of an aggregate material.
- Group A Leachate Sub-samples: as received samples (no preparation prior to analysis). For subsamples A1, A2 and A3, no large particles were removed prior to leaching. Commonly laboratories may remove larger particle sizes so that 95 % of material remaining has a diameter of <4 mm (clay to very fine gravel) in line with IS EN 12457.
- Group B Leachate Sub-samples: Crushing of materials for subsamples B1, B2 and B3 was undertaken using a roller crusher as specified in IS EN 12457. Crushing took place until 95 % of materials had a diameter of < 4 mm. For this method the larger aggregate grains excluded from the Group A Leachate Sample were crushed into smaller grains.
- Group C Leachate Subsamples: For Subsample C1 material was ground to a fine powder (<0.212 mm) using a Retsch RS2000 Vibratory Disc Mill Grinding Machine.

These three different preparation methods allow a comparison to be made between leachability and sample grain size, i.e., does grinding to a fine powder increase leachability compared to that from larger grain sized materials?

Figure A Flow Chart Summarising Sample Preparation



Photographs of crushing and grinding equipment used is included in Appendix I. Both the roller crushing and grinding machine are made from a similar hardened chrome steel, which contains copper, chromium and nickel. The Retsch grinder is monitored monthly for deterioration by the laboratory. A material (aluminium oxide) with a hardness greater than hardened chromium steel is crushed by the grinder, then analysed for metals. Results of this analysis for October, November and December 2022 have been supplied by Element. In analysed materials, chromium concentrations between 75.8 and 123.1 mg/kg, nickel concentrations between 1.9 and 7.8 mg/kg and copper concentrations between 1 and 7 mg/kg, are reported indicating that some erosion of the grinder surfaces by the aluminium oxide is taking place. Materials in our experiments (concrete and natural aggregates predominantly comprising silicate and carbonate minerals) have a lower hardness than aluminium oxide and less erosion of the grinder by materials, and hence lower levels of contamination of samples by metals within the grinder, is expected. Potential contamination by metals from erosion of grinding equipment is further discussed in the results section.

Following subdivision, the experimental set-up and subsequent analysis of the sample groups for each of the six aggregate samples was as follows:

- Solid Subsamples and Group C Leachate Subsamples: these subsamples were stored indoors and analysed within 7 days (of the sample sub-division). No further storage time or analysis was subsequently undertaken on these groups.
- Group A and B Leachate Subsamples: These subsample groups will represent the most likely aggregate grain sized fractions to be analysed by laboratories The potential effects of storage/stockpiling times on leaching were tested as follows:
    - Each subsample group was split into three further subsets:
        - one to be stored indoors and be analysed within 7 days (subsamples A1 and B1).
        - two sub-sets to be stored outdoors, with a group (subsamples A2 and B2) analysed after 3 weeks exposure and another subset (subsamples A3 and B3) after 6 weeks exposure. Each subsample group comprised 6 aggregate samples to account for sample variability, resulting in 24 samples in total.
    - The subsamples to be held for 3 of 6 weeks outdoors were placed in an open plastic high density polyethylene (HDPE) vessel 10 cm in diameter each containing approximately 500 g of aggregate. The open vessel allowed rainwater to mix with the subsamples. The base of each container had a hole to allow drainage of any excess rainwater. The aggregate was held in a fabric mesh within the vessels to prevent washing away of material by the rain. This process was designed to mirror the outdoor storage of aggregate materials in areas open to the elements (weather) by producers.

As noted in Section 1 above and within the main body of the End-of-Waste Technical Information "Development of Pollutant Limit Values for Recycled Aggregate Products" report, the storage/stockpiling of aggregate (often when exposed to the weather) before use can potentially lead to the reduction in leachable concentrations as a result of carbonation. The storage of subsamples from Leachate Subsample Groups A and B for 3 or 6 weeks prior to analysis was aimed at testing the potential effects of short-duration outdoor storage and leachability, and providing insights into the possible effects of the carbonation process.

An in-depth discussion of the carbonation process is included in Section 5.1 of the main body of the End-of-Waste Technical Information "Development of Pollutant Limit Values for Recycled Aggregate Products" report. The carbonation process on concretes is the reaction of calcium hydroxide and calcium silicates on the surface of the concrete with carbon dioxide in the air to form a calcium carbonate and silica gel outer layer of the concrete. This layer acts to seal exposed surfaces and forms a natural barrier reducing the leachability of otherwise soluble constituents. The carbonation process occurs more rapidly in humid conditions especially with intermittent saturation (i.e. rainfall). It is considered likely that the carbonation process will occur to some extent on concrete Recycled Aggregate surfaces as they are stored outdoors post crushing and prior to use. Outdoor storage of the remaining subsamples was designed to simulate the carbonation process. Carbonation may also occur on natural rocks (virgin rock aggregate) with the conversion of silicate minerals to their carbonate salts.

Group A and B Leachate Subsample open sample vessels were placed in a 1 m by 1.2 m cage and positioned outdoors on 30th November 2022. Weather conditions for when the samples were stored outdoors are summarised in Table B for Met Office Ness WS Observation Site (approximate United Kingdom National Grid Reference 329850, 376460) located approximately 7 km northwest of the Element laboratory, with temperature given to the nearest degree. Key features of the exposure period are summarised below:

- The first nine days of the outdoor exposure period was characterised by cold, dry weather and forecasts at the time indicated that this was set to remain for at least another week. The aim of the experiment was to assess the effects of exposure to typical 'average' humid/mild weather conditions to see whether this can reduce the leachability of samples. The carbonation process is known to be much slower in dry and cold conditions as opposed to humid/mild conditions present throughout most of the year. Given this understanding, and the short duration of exposure (3 weeks (21 days) to 6 (weeks 42 days)), an extended period (10+ days) of cold dry was considered to represent too long a period relative to the length of the experiment and could potentially adversely affect results. As such, it was decided to bring the samples indoors so that samples could be exposed to milder climatic conditions while the forecast remained uncertain.
- On 9th December 2022 (Day 10) the subsamples were brought inside and placed in an unheated warehouse room, after being wetted for 2 to 3 hours following a rain shower.

- Between 12th (Day 13) and 20th December 2022 (Day 21) wet weather conditions were replicated indoors for the subsamples as follows:
    - On each weekday samples were sprayed with 20 ml of deionised water that had been left open to the air in order to equilibrate with atmospheric CO_2 and reduce its pH so that it was similar to rainwater.
    - On the 13th December 2022 (Day 14) the A3 and B3 subsamples were identified to have clumped together a little due to moisture. On 14th December 2022 (Day 15) these subsamples were gently stirred with a stainless-steel spoon. The temperature of the room the samples were stored in, and the pH of the deionised water used to spray the subsamples is presented in Table C.
- The approximate 20 ml of deionized water added per day is approximately equivalent to the average volume of rainwater that would be expected to fall over a 10 cm diameter circular area over one day, for a location experiencing 1000 mm/year of rainfall[1].
- The range of measured indoor temperatures between 12th and 21st December 2022 varied between 11.5 and 16.5°C. Although these are higher than the cold temperatures observed outdoors during this period, they are similar to maximum temperatures observed between the 27th December 2022 (Day 28) and 10th January 2023 (Day 42) at the Ness WS Observation Station, and also likely closer to long term average annual temperatures as well. The measured pH of the deionized water used to spray the samples varied between pH 5.17 and 6.43 (median value of pH 5.69). This is similar to the pH of clean (uncontaminated) rain (pH 5.0 to 5.5)[2].
- On the 20th December 2022 (Day 21) leachate subsamples A2 and B2 for each of the six Aggregate Samples were prepared for leach testing and were not watered.
- On the 21st December 2022 (Day 22), the remaining subsamples A3 and B3 for each of the six Aggregate Samples were placed back outdoors as the weather forecasts indicated a period of milder, wetter conditions.
- On 10th January 2023 (Day 42) the remaining subsamples were taken back inside and prepared for leach testing on the 11th January 2023.

Leach testing preparation and analysis for all subsamples was undertaken in accordance with BS EN 12457-2 for single stage leaching tests with a liquid: solid ration of 10:1.

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[1] The exact estimated value is 21.5 ml

[2] https://www3.epa.gov/acidrain/education/site_students/phscale.html (Viewed on 12 January 2023)

Table B Weather Log at Met Office Ness WS Obs. Station, the closest Weather Station to the Laboratory

Date	**Day**	**Met Office Ness Weather Station Data**			**Sample Storage Location**
		Temperature, Min (°C)	**Temperature, Max (°C)**	**Rainfall (mm)**	
30/11/2022	1	3	4	0	Outdoors
01/12/2022	2	3	6	0	
02/12/2022	3	2	4	0	
03/12/2022	4	2	6	0	
04/12/2022	5	2	6	0.5	
05/12/2022	6	4	7	0	
06/12/2022	7	2	6	0	
07/12/2022	8	0	6	0	
08/12/2022	9	-1	4	0	
09/12/2022	10	-1	5	8.3	Brought Indoors
10/12/2022	11	0	2	16.3	Indoor Temporary Storage
11/12/2022	12	-3	2	0.3	
12/12/2022	13	-6	-1	0	
13/12/2022	14	-5	0	0.2	
14/12/2022	15	-5	1	0	
15/12/2022	16	-4	4	0	
16/12/2022	17	-3	5	0	
17/12/2022	18	0	4	0.2	
18/12/2022	19	0	8	2	
19/12/2022	20	8	14	0.5	
20/12/2022	21	5	9	1.8	
21/12/2022	22	5	9	1.1	Taken Outdoors
22/12/2022	23	5	7	0.2	Outdoors
23/12/2022	24	6	8	14	
24/12/2022	25	8	6	0	
25/12/2022	26	6	10	4.6	
26/12/2022	27	4	7	1.5	
27/12/2022	28	3	11	1.8	
28/12/2022	29	6	11	1	
29/12/2022	30	5	9	4.1	
30/12/2022	31	6	12	0	
31/12/2022	32	8	10	12.4	
01/01/2023	33	4	9	5.9	
02/01/2023	34	2	8	1.8	
03/01/2023	35	1	14	1.5	
04/01/2023	36	10	14	0	
05/01/2023	37	8	12	2.5	
06/01/2023	38	7	11	0.3	
07/01/2023	39	7	11	4.3	
08/01/2023	40	4	8	2.1	
09/01/2023	41	4	8	1	
10/01/2023	42	5	14	11.4	

Table C Indoor Conditions During Time Subsamples Were Stored Inside

Date	**Indoor Temperature**		**Volume Deionised Water Added (ml)**	**pH of Deionised Water)**
	Temperature, Min (°C)	**Temperature, Max (°C)**		
09/12/2022	-	-	-	-
10/12/2022	-	-	-	-
11/12/2022	-	-	-	-
12/12/2022	11.5	13.6	20	6.18
13/12/2022*	13.3	14.9	20	6.43
14/12/2022	13.5	16.1	20	5.66
15/12/2022	14	16	20	5.75
16/12/2022	14	16.3	20	5.17
17/12/2022	-	-	-	-
18/12/2022	-	-	-	-
19/12/2022	12.1	15.2	20	5.69
20/12/2022	15.1	16.4	20*	5.18

Note:* A3 and B3 subsamples for each of the six Aggregate Samples not sprayed on this day

2.3 Sample Analysis

Laboratory analysis included:

- Totals Analysis of six Solid Subsamples, one for each of the six Aggregate Samples, for:
  - As, Ba, Cd, Cr total, Cr (VI) Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn, V, K, Ca, Al, chloride, fluoride, sulphate, total organic carbon and pH, all in singular, no duplicates.
  - USEPA polycyclic aromatic hydrocarbons 16 compounds, total petroleum hydrocarbon criteria working group C5-C44 fractions, benzene, toluene, ethylbenzene, xylene, speciated phenols, polychlorinated biphenyls and semi-volatile organic compounds plus tentatively identifiable compounds (7 congeners), all in singular, no duplicates
- Analysis of 42 Leachate Subsamples (A1, A2, A3, B1, B2, B3 and C1), 7 for each of the 6 Aggregate Samples, according to BS EN 12457 Leachate analysis (10:1 Leachate to Solid ratio) for:
  - As, Ba, Cd, Cr total, Cr (VI), Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn, V, K, Ca, Al, chloride, fluoride, sulphate, dissolved organic carbon and pH, **all in duplicate**.
  - USEPA polycyclic aromatic hydrocarbons 16 compounds, total petroleum hydrocarbon criteria working group C5-C44 fractions, benzene, toluene, ethylbenzene, xylene, speciated phenols, and polychlorinated biphenyls (7 congeners), all in singular, no duplicates.
- Analysis of 18 Leachate Subsamples (A1, B1 and C1), 3 for each of the 6 Aggregate Samples, for semi-volatile organic compounds plus tentatively identifiable compounds, all in singular, no duplicates.

Full laboratory preparation and analysis methods are detailed in the Laboratory Certificates included in Appendix Y.

3 RESULTS AND DISCUSSION

Summary laboratory chemical analysis results tables are included in Appendix III. These include:

- Tables III-1 to III-4: which provide a summary of total and leachable inorganic and metal concentrations and detectable hydrocarbon concentrations;
- Table III-5 provides a comparison of total and leachable concentrations for key chemicals; and,
- Tables III-6 to Table III-9: where results from this assessment have been screened against Pollutant Limit Values (PLVs) and Solid Pollutant Limit Values (S-PLVs).

Summary graphs showing key results are presented in Appendix IV, while Chemical Laboratory Certificates are included in Appendix V.

Below is a summary and discussion of the salient trends observed in the data.

3.1 pH

3.1.1 pH from Concrete Samples

The measured pH of the solid subsample of the concrete Aggregate Samples (A1, C1, C2 and C3) varied between pH 11.5 to 12.5[3],which is similar to the pH of the leachate from the A1 Leachate Subsamples, leached and analysed directly after preparation (with no crushing or grinding) which varied between pH 11.2 and 12.3.

Prior to sampling, various crushed concrete sources were stockpiled for varying periods of time by the producer (See Table A). In A1 Leachate Subsamples, tested on receipt at the laboratory (without crushing or grinding at the laboratory), there was no clear relationship between leachable pH and the period of time the crushed concrete aggregate spent outdoors in stockpiles at the aggregate producer, post its crushing and prior to sampling by Geosyntec. Results are summarised as follows for the A1 Leachate Subsamples:

- pH 11.2-11.3 measured for Aggregate Sample A1 (3 weeks in producer's stockpile),
- pH 12.1 measured for Aggregate Sample C1 (<3 days in the producer's stockpile)
- pH 11.4 measured for Aggregate Sample C2 (1 week in the producer's stockpile); and,
- pH 12.3 measured for Aggregate Sample C3 (6 months in the producer's stockpile).

If the composition of each concrete aggregate was the same and carbonation of the concrete aggregate surface was taking place in the stockpile the pH leaching from the aggregates would be expected to decrease the longer the aggregate was stockpiled. However, this was not observed in the samples taken. This lack of observable trend may be due to slightly different compositions in each Aggregate Sample (as detailed in Table A), rather than no carbonation taking place on the samples.

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[3] Measured as extraction of as received solid subsamples using one part solid to 2.5 parts deionised water.

The Recycled Aggregate subsamples that were tested on receipt at the laboratory were either tested as received (A1 Subsamples), tested following being crushed to 95% < 4mm (B1 Subsamples) or tested following being ground to <0.2 mm (C1 Subsamples). For the more highly crushed/ground subsamples the surface area available for leaching would be higher for a given mass and higher pH values may be expected. The following pH trends, as shown in detail in Table III-5 and in Figure IV1 in Appendix IV, were observed for these subsamples:

- For the A1 Aggregate Sample the pH of the subsample tested as received (with no crushing or grinding) was pH 11.2 – 11.3. For the subsample crushed to 95 % < 4 mm the pH was 9.85 to 11.4 and in the sample ground to <0.2 mm the pH was 11.7. There was no clear trend for this sample.
- For the C1, C2 and C3 Aggregate Samples a minor rise in pH was measured with increasing crushing/surface area available for leaching. For example for the C1 Aggregate Sample a pH of 12.1 was recorded in the tested as received subsample, this increased to pH 12.1 – 12.2 in the crushed to 95% < 4 mm subsample and pH 12.4 in the in samples ground to <0.2 mm.

The data suggests crushing of concrete aggregate samples for leachate analysis in the laboratory may lead to a small increase in recordable pH.

As well as Recycled Aggregate subsamples being tested on receipt at the laboratory (A1, B1 and C1 Leachate Subsamples), they were also tested following 3 weeks exposure time to the elements (A2 and B2 Leachate Subsamples) and following 6 weeks exposure time to the elements (A3 and B3 Subsamples). This was undertaken to simulate potential stockpiling of aggregate outdoors. For each Aggregate Sample, each of the (no crushing or grinding) Group A Leachate Subsamples and (crushed to 95% < 4 mm) Group B Leachate Subsamples came from the same original homogenised sample. Differences in leachability with exposure time would therefore be expected to be due to carbonation, rather than difference in the composition of samples.

A clear decrease of pH is observed with increased time that the concrete aggregate subsamples spent open to the elements post preparation allowing for carbonation. After 3 weeks (21 days) exposure leachable pH dropped on average by 0.205 pH units (range 0.05 to 0.45 pH units). After 6 weeks (42 days) the leachable pH of the concrete subsamples varied between pH 9.84 and 11.4. The leachable pH of the concrete samples dropped on average 0.78 pH units (range 0.175 to 1.15 pH units) over the full 6 weeks exposure time.

The experiment shows that leachate pH for a given concrete aggregate sample will likely decrease over time when exposed to rain and the atmosphere.

3.1.2 pH from Natural Aggregate Samples

The measured pH of the solid subsample of the natural Aggregate Samples B1 and B2 was pH 9.23 and 9.3 respectively[4],which is similar to the pH of the leachate from the A1 Leachate Subsamples,

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[4] Measured as extraction of as received solid subsamples using one part solid to 2.5 parts deionised water.

leached and analysed directly after preparation (with no crushing or grinding) of the aggregate samples, which varied between pH 9.27 and 9.93.

No clear trends of pH were observed with increasing time that the Aggregate Sample was left in a stockpile prior to sampling and the amount of crushing that took place in leachate samples prior to analysis. The pH trend was similar in the leachate subsamples for the B1 Aggregate Sample (sample collected after 1 week in the stockpile) with that for the B2 Aggregate Sample (sample collected after 4 weeks in the Stockpile). For both the B1 and B2 Aggregates Samples the pH of A2 Leachate Subsamples (crushed to 95 % < 4 mm) was greater than that of the A1 Leachate Subsamples (tested as received) by 0.07 to 2.2 pH units. This was expected, as the crushed sample grains have a greater surface area exposed to leaching per sample mass. However, the pH of the A3 Leachate Subsamples (ground to <0.2 mm), which would be expected to be the highest as the subsample's grains have the highest surface area to mass ratio, were within the same range as the A1 Leachate Subsamples.

A clear decrease of pH is observed with increased time that the natural aggregate subsamples spent open to the elements post preparation allowing for carbonation. After 3 weeks (21 days) exposure leachable pH dropped on average by 0.62 pH units (range -0.04 to 1.48 pH units). After 6 weeks (42 days) the leachable pH of the concrete subsamples varied between 8.23 to 9.45 pH units. The leachable pH of the natural aggregate samples dropped on average 0.93 pH units (range 0.47 to 1.49 pH units) over the full 6 weeks exposure time. This suggest that the leachate pH for a given natural aggregate sample will likely decrease over time when exposed to rain and the atmosphere.

3.2 Metals

3.2.1 Chromium

Total chromium solid subsample concentrations of the A1, C1, C2 and C3 concrete Aggregate Samples (24.1 to 48.4 mg/kg) were similar to that of the B1 and B2 natural Aggregates Samples (28.8 mg/kg to 29.2 mg/kg). However, the leachable total chromium concentrations in A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding) were markedly higher in the concrete samples than the natural samples (as shown in Table III-5). For the A1 Leachate Subsamples leachable total chromium varied between 0.104 and 0.465 mg/kg for concrete Aggregate Samples, whilst for natural Aggregate Samples it was not detected (<0.015 mg/kg). The higher total chromium leachability from concrete samples may in part be due to the presence of chromium VI within the concrete. Chromium VI was not detected in either the solid subsamples for concrete or natural aggregate. It also was not detected in any natural aggregate leachate subsamples. However, it was detected at up to 0.26 mg/kg in A1 Leachate Subsamples for concrete aggregates representing up to 56 % of the leachable chromium mass. Chromium VI can be formed by the heating of natural rocks to form cement (see End-of-Waste Technical Information main report Section 5.3 for more detail). Chromium VI also tends to be soluble in water with solubilities over 500 g/L (IARC 2012), compared with chromium III which for the most part forms insoluble species[5]. Therefore even though chromium VI may form only a small portion of the total chromium mass it may represent a large portion of the leachable mass.

As observed with pH there was no measured increase or decrease with leachable total chromium or chromium VI mass with the amount of time that aggregate spent outdoors in stockpiles at the aggregate producer, prior to sampling by Geosyntec. For example, the total chromium concentration in A1 Leachate Subsamples for the:

- A1 Aggregate Sample (stockpiled for 3 weeks) were 0.131 and 0.151 mg/kg.
- C1 and C2 Aggregate Samples (stockpiled for <3 days and 1 week respectively) were between 0.285 and 0.465 mg/kg.
- C3 Aggregates Sample (stockpiled for 6 months) were 0.093 and 0.105 mg/kg.

This lack of trend may reflect differences in the composition of the concrete aggregate samples.

In both concrete and natural aggregates an increase in total chromium and chromium VI leachability was measured in most cases with the amount a subsample was crushed/ ground prior to leaching, as can been seen in Figure IV2 and Figure IV3 in Appendix IV:

- In two concrete Aggregate Samples (A1 and C2) the leachability of total chromium and chromium VI clearly increased with the amount of crushing taking place. For concrete Aggregate Sample A1, in the A1 Leachate Subsample, which was analysed directly after preparation (with no crushing or grinding), the leachable total chromium was recorded at 0.131 and 0.151 mg/kg and chromium VI was detected in one of the two duplicate samples at 0.07 mg/kg. In the B1 Leachate Subsample crushed to 95 % <4 mm, 0.259 mg/kg and 0.435 mg/kg total chromium were detected, with 0.11 and 0.39 mg/kg chromium VI detected. Finally, in the C1 Leachate Subsample ground to <0.2 mm, 0.822 mg/kg of total chromium was detected and up to 0.79 mg/kg of chromium VI was detected.
- In the C1 and C3 concrete Aggregate Samples no clear increase or decrease of leachable total chromium or chromium VI concentration was measured, relative to the amount the material had been crushed/ ground.
- In the B1 and B2 natural Aggregate Samples no leachable chromium is detected in the leachate subsamples analysed directly after preparation (with no crushing or grinding) by the laboratory. Following crushing to 95% <4 mm, total chromium was detected in the B1 Aggregate Sample at up to 0.03 mg/kg and after grinding to <0.2 mm, total chromium was detected in both B1 and B2 Aggregate Samples at up to 0.019 mg/kg. No leachable chromium VI was detected in either sample. No leachable chromium VI is identified in any natural aggregate samples.

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[5] https://www.lenntech.com/periodic/water/chromium/chromium-and-water.htm
Visited 31st January 2023

This increase of leachability with crushing/ grinding is considered likely to reflect a higher surface area to volume ratio of grains in the more crushed samples. The low levels of chromium recorded in natural aggregates may reflect contamination of the subsample by the crushing and grinding equipment. The maximum leachate concentrations in the natural aggregate samples are typically 10 % or less than that observed in concrete aggregate samples that have been crushed and ground. This suggests that if contamination from the laboratory equipment is occurring it would only be having a minor influence on the leachable chromium results in concrete aggregates and would not affect the conclusions in this study.

The leachability of total chromium decreased with the time samples exposed to the elements between sample preparation and analysis for all aggregate samples, except for concrete Aggregate Sample C3. This is most clearly observed in the concrete C2 Aggregate Sample. The leachable total chromium of the subsamples analysed directly after preparation (with no crushing or grinding) reduced from 0.40 - 0.47 mg/kg at 0 weeks, to around 0.14 mg/kg at 6 weeks. A similar decrease was observed in the subsamples crushed to 95 % < 4 mm. Exceedances of the total chromium PLV were identified in samples exposed to the elements for 0 and 3 weeks, but not in samples exposed to the elements for 6 weeks.

Leachable total chromium was only detected in natural Aggregate Samples B1 and B2 in samples that had undergone crushing/grinding and were tested within 7 days with no outdoor storage. No detectable leachable chromium VI was recorded across all subsamples in the two aggregate samples. Total chromium and chromium VI leachable concentrations are summarised in Table 5 in Appendix III.

The above indicates that the storage of concrete or natural aggregates outdoors in conditions where carbonation can take place generally reduces the leachability of total chromium and chromium VI. When carbonation takes place on the surface of concrete a silica gel forms as wells a crystalline calcite (You et al 2011). In this gel, calcium can replace silica causing the creation of negative charged sorption sites at which heavy metal ions can adsorb. This is considered a potential mechanism for the reduction in leachability of chromium (total and VI) as the carbonation process takes place.

3.2.2 *Barium, Calcium, Potassium*

Barium, calcium and potassium were measured at similar total concentrations in natural aggregates and concrete aggregates. Total barium concentrations between 32 and 66 mg/kg were recorded in solid subsamples. For calcium, total concentrations in solid subsamples ranged between 97,500 and 244,000 mg/kg and for potassium, total concentrations were between 478 and 1,170 mg/kg.

Greater variation was observed in leachate subsamples. In A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding), leachable concentrations were greater in concrete samples than in natural aggregate samples. For example, for the A1 Leachate Subsample, potassium concentrations for concrete Aggregate Samples (A1, C1, C2 and C3) varied between 63 and 260 mg/kg while for natural Aggregate Samples (B1, B2), potassium concentrations varied between 4 and 7 mg/kg.

As observed with chromium, there was no measured increase or decrease in leachable total barium or calcium from subsamples with the amount of time aggregate spent outdoors in stockpiles at the aggregate producer, prior to sampling by Geosyntec.

A trend was observed for potassium in concrete aggregates samples, with decreasing leachability measured with increasing stockpile time in the as-received A1 Leachate Subsamples:

- For the C1 Aggregates Sample stockpiled for <3 days, potassium was recorded at 259 and 260 mg.kg
- For the A1 Aggregate Sample stockpiled for 3 weeks, potassium was recorded at 192 and 237 mg/kg
- For the C2 Aggregate Sample stockpiled for 1 week, potassium was recorded at 121 and 132 mg/kg
- For the C3 Aggregate Sample stockpiled for 6 months, potassium was recorded at 63 and 76 mg/kg

This trend could be evidence of carbonation taking place on concrete aggregate surfaces in stockpiles or reflect compositional variability in the different aggregate stockpiles.

Barium, calcium and potassium all exhibited higher leachate concentrations the more a given subsample was crushed/ ground prior to analysis, as shown in Figure IV4 to IV6 in Appendix IV. An increase in leachability with crushing/grinding was observed in most aggregate samples, with greater effects seen in concrete samples than natural aggregates samples. For example for the concrete C1 Aggregate Sample calcium was recorded at:

- 2190 and 2210 mg/kg in A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding);
- 2430 and 2720 mg/kg in B1 Leachate Subsamples analysed after being crushed to 95 % <4 mm; and,
- 4200 mg/kg in C1 Leachate Subsamples, tested after being ground to <0.2 mm.

As with chromium, this increase of leachability with crushing/ grinding is considered likely to be due to a higher surface area to volume ratio of grains in the more crushed/ground samples.

The leachability of barium, calcium and potassium was observed to decrease with the time samples were exposed to the elements post sample preparation and pre analysis, in all aggregate samples. This trend is clearly seen in concrete aggregate samples, with more marginal changes measured in natural aggregate samples. For example, for barium:

- A clear trend is observed in the concrete C3 Aggregate Sample. The leachable barium for subsamples analysed directly after preparation (with no crushing or grinding) reduced from 1.12 and 1.37 mg/kg at 0 weeks, to around 0.1 mg/kg at 6 weeks.

- A marginal change was observed in the natural B2 Aggregate Sample. The leachable barium for the subsamples analysed directly after preparation (with no crushing or grinding) was 0.05 and 0.06 mg/kg at 0 weeks. This rose slightly to 0.07 and 0.11 mg/kg at 3 weeks, but then decreased to <0.03 mg/kg after 6 weeks.

A reduction of calcium leachability with increased carbonation is expected. Calcium is locked up when carbonation takes place due to the conversion of the more soluble calcium hydroxides to calcite (calcium carbonate) upon reaction with carbon dioxide from the atmosphere (HazWasteOnline™ 2020). The formation of calcite leads to a thin crust or patina forming in the surface of the concrete sample which helps to cover and seal underlying minerals and in so doing reduces the leachability of not only calcium but of other metals as well. Barium is a divalent metal like calcium and can also form carbonates on reaction with carbon dioxide to form minerals such as Witherite (Deer, Howie & Zussman, 1992), so barium leachability can also directly be reduced by the carbonation process. Potassium is considered likely to be co-precipitating with calcite formed during the carbonation process. Ishikawa and Ichikuni (1986) note that potassium can enter interstitial spaces in the calcite mineral lattice in marine shells.

A single anomalous calcium subsample result was identified. The concrete C1 Aggregate Sample, A3 Leachate Subsample (a <30 mm aggregate left for <3 days prior to sampling and with no crushing and then 6 weeks exposure post receipt), returned an original calcium leachate concentration of 7,680 mg/kg. The sample passed the QA/QC tests for the laboratory; however, the concentration was much larger than that recorded in its duplicate (473 mg/kg), which raised questions about the validity of the original result. Re-analysis of the anomalous sample returned a calcium concentration of 379 mg/kg, which is similar to the concentration recorded for the duplicate sample. The anomalous sample may be due to laboratory error and the original data point has been excluded from the dataset for assessment.

3.2.3 *Copper, Molybdenum, Nickel and Zinc*

In all aggregate solid subsamples, copper (10 to 35 mg/kg), molybdenum (1.5 to 2.2 mg/kg), nickel (14.5 to 24.8 mg/kg) and zinc (42 to 57 mg/kg) were identified at low concentrations.

In Leachate Subsamples analysed directly after preparation (with no crushing or grinding), concentrations of copper, molybdenum, nickel and zinc were low or non-detect (i.e. below the respective proposed PLVs):

- Copper and nickel were detected in 2 out of 4 concrete aggregate leachate subsamples with maximum concentrations of 0.17 mg/kg and 0.03 mg/kg recorded, respectively. Copper and nickel were not detected in natural aggregate A1 Leachate Subsamples.
- Molybdenum was detected in one concrete (C1) and one natural (B1) aggregate leachate subsample with a maximum concentration of 0.06 mg/kg recorded.
- Zinc was not detected in any leachate samples.

Low levels of copper and nickel in ground or crushed natural aggregate samples may indicate potential contamination of samples from laboratory grinding/crushing equipment. However, in natural Aggregate Samples B1 and B2 no detectable copper or nickel was identified in leachate generated from crushed or ground subsamples.

Similar to other metals (apart from potassium), there was no clear increase or decrease of leachable copper, molybdenum, nickel or zinc concentrations with the amount of time an aggregate spent outdoors in stockpiles at the aggregate producer, prior to sampling by Geosyntec.

Molybdenum concentrations in leachate subsamples increased with the amount that a subsample had been crushed/ground prior to leachate analysis for 3 out of 6 Aggregate Samples (A1, B1 and B2). For example, for the concrete A1 Aggregate Sample which came from a stockpile approximately 1 month old, no molybdenum was detected (<0.02 mg/kg) in the leachate subsample analysed directly after preparation (with no crushing or grinding), 0.02 and 0.04 mg/kg molybdenum was detected in the crushed to <95 % < 4 mm leachate subsample, and 0.14 mg/kg was measured in the ground to <0.2 mm leachate subsample. No clear trends were observed for leachable molybdenum, in the C1, C2 and C3 Aggregates Samples.

Similarly, no clear trends were observed for leachable copper, nickel and zinc in any aggregate samples, although in all cases the results were very low or below laboratory detection limits. As such, any trends would not be easily observable.

More detections were measured for copper, molybdenum and nickel in the leachate of subsamples analysed straight after preparation compared to those exposed to the elements for 3 to 6 weeks between preparation and leaching, as observed in Figure IV7 to IV10 in Appendix IV. For example, for copper in the (no crushing or grinding) Group A Leachate Subsamples, detectable concentrations were measured in 2 out of 6 aggregate samples tested after 0 weeks exposure time, 1 out of 6 samples tested after 3 weeks exposure time and 0 out of 6 samples tested after 6 weeks exposure time.

For zinc only 5 detects of leachate concentrations across all 84 Leachate Subsamples analysed were identified and no trends could be identified.

Copper, molybdenum, nickel and zinc form positively charged ions in water, like chromium, and there is considered potential for these metals to adsorb onto negatively charged sorption sites on carbonated surfaces. Experiments by Pellegrini et al. (2013) identified copper, nickel and zinc to absorb well onto the surface of carbonated cement. This reaction could explain the small decreases in leachability of metals measured after the leachate subsamples were exposed to the elements in laboratory experiments.

3.2.4 Vanadium

Vanadium was recorded between 15 and 34 mg/kg in solid subsamples and was recorded in all Leachate Subsamples, but in all cases at concentrations below proposed PLVs. In the A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding), vanadium was recorded up to 0.134 mg/kg in concrete aggregates (C2 Aggregate Sample) and up to 0.038 mg/kg in natural aggregates (B1 Aggregate Sample).

No clear trend was measured in vanadium leachability in the concrete aggregate A1 Leachate Subsamples relative to the amount of time an aggregate spent outdoors in stockpiles at the aggregate producer, prior to sampling by Geosyntec. Recorded leachable concentrations were lowest in the C1 and C3 Aggregate Samples which were stockpiled for <3 days (max 0.016 mg/kg) and 6 months (all samples <0.016 mg/kg) respectively. Vanadium concentrations were higher for the C2 Aggregate Sample, which was stockpiled for 1 week (0.134 mg/kg max) and the A1 Aggregate Sample which was stockpiled for 3 weeks (max 0.09 mg/kg). This lack of trend could be due to compositional differences in each of the concrete aggregate samples.

The leachability of vanadium, as shown in Figure IV11 in Appendix IV, shows variable trends with the amount the material is crushed or ground prior to leachate analysis for concrete and natural aggregates:

- The leachability of vanadium in the concrete A1 and C2 Aggregates Samples decreased the more the samples was ground. For the A1 Aggregate Sample, 0.081 and 0.09 mg/kg was detected in the subsample analysed directly after preparation (with no crushing or grinding), 0.073 and 0.087 mg/kg in the 95 % crushed to <4 mm subsample, and 0.055 and 0.063 mg/kg in the subsample crushed to <0.2 mm.
- For natural B1 and B2 Aggregates Samples the leachability of vanadium in the crushed and ground subsamples was greater than the subsample analysed directly after preparation (with no crushing or grinding). For the B1 Aggregate Sample, 0.019 and 0.038 mg/kg was leachable in the as-received subsample, 0.115 and 0.116 mg/kg in the 95 % crushed to <4 mm subsample and 0.062 to 0.075 mg/kg in the crushed to <0.2 mm subsample.
- No clear increase or decrease of leachability of vanadium was measured for the concrete C1 and C2 Aggregate Samples.

For natural aggregate samples there appears to be no clear increase or decrease of vanadium leachability with the time a subsample is exposed to the elements between laboratory preparation and leachate analysis. For concrete aggregate samples the leachability of vanadium in all samples increased with the amount of time the subsample was outdoors exposed to the elements. For example, for the C2 Concrete Aggregate Sample for the as-received (no crushing or grinding) Group A Leachate Subsamples: 0.112 and 0.134 mg/kg vanadium was leached after 0 weeks exposure time, 0.175 and 0.222 mg/kg after 3 weeks exposure time and 0.239 and 0.257 mg/kg after 6 weeks exposure time.

The trends measured for vanadium are different from those seen for other metals and the leachability of vanadium is therefore considered unlikely to be related to the amount of aggregate grain surface area available for leaching and sorption onto sorption sites as per other metals. The most common valence states for vanadium are +3, +4 and +5. Vanadium when in the trivalent state (+3) can naturally substitute for iron in mineral structures (Gilligan and Nikoloski, 2020). High temperatures (such as during the production of cement from natural minerals) could turn vanadium within common iron minerals into soluble sodium vanadate (Gilligan and Nikoloski, 2020). This process is commonly used to extract vanadium from minerals for industry. Therefore, soluble vanadium may naturally be present in concrete. The data from the current study suggests that the carbonation process may release these soluble sodium vanadate species in concrete aggregates, with increased rate of release for the aggregate samples stored outdoors exposed to the elements.

3.2.5 Aluminium

Aluminium was measured at elevated total concentrations in natural and concrete aggregate sample solid subsamples (3,860 to 12,300 mg/kg). It is likely present in concrete within ballast materials, with aluminium being a common mineral-forming element, such as within aluminosilicate minerals including feldspars (Deer, Howie & Zussman, 1992). In addition, the man-made mineral tricalcium aluminate is added to cement along with gypsum (which can make 3-5 % of the cement mass) to form protective ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12}.26H_2O$) films over the cement particles (Zhang 2011). The amount of aluminium detected in samples is likely related to the type and quantity of various aluminosilicate minerals within ballast added to the concrete mixture and the ettringite/ tricalcium aluminate present.

High leachate concentrations of aluminium were observed in natural aggregate and concrete samples. There is no proposed PLVs for aluminium. For natural B1 and B2 Aggregate Samples, similar concentrations in leachate were measured in the A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding), with values between 2.1 and 4.5 mg/kg recorded. For concrete aggregate samples, leachable aluminium concentrations for the A1 Leachate Subsamples were identified to generally increase with increasing time the crushed concrete aggregate spent outdoors in stockpiles at the aggregate producer, prior to sampling by Geosyntec, with leachable concentrations at 3 weeks and 6 months stockpile time greater than those recorded at <3 days and 1 week stockpile time:

- 4.3 to 5 mg/kg measured for Aggregate Sample C1 (<3 days in the producer's stockpile);
- 2.6 to 5.6 mg/kg measured for Aggregate Sample C2 (1 week in the producer's stockpile);
- 9.4 to 11.2 mg/kg measured for Aggregate Sample A1 (3 weeks in producer's stockpile); and,
- 8.2 to 9.2 mg/kg measured for Aggregate Sample C3 (6 months in producer's stockpile).

However, the above changes could also relate to compositional differences between the different concrete samples. The leachability of aluminium, as shown in Figure IV12 in Appendix IV, does not show a clear trend relative to the amount the material is crushed or ground prior to leaching for the A1, C1 and C2 concrete Aggregate Samples. For the natural B1 and B2 Aggregate Samples and the concrete C3 Aggregate Sample, the leachable aluminium concentrations in the subsamples ground to < 0.2 mm were lower than in the as-received (no crushing or grinding) subsamples and the crushed to 95 % < 4 mm subsamples. For example, the B2 Aggregate Sample (stockpiled for 4 weeks before sampling) recorded concentrations of 0.6 and 0.7 mg/kg in the ground to <0.2 mm subsamples and between 2.1 and 3.4 mg/kg in the crushed to 95 % <4 mm and tested as-received subsamples.

The leachability of aluminium was identified to vary with the amount of time that a subsample was exposed to the elements:

- Two of the concrete Aggregate Samples (A1 and C2) showed a decrease in aluminium leachability with increasing time that subsamples were exposed to the elements;
- The two natural Aggregate Samples (B1 and B2) and one concrete Aggregate Sample (C1) showed no increase or decrease of leachability with increasing time the subsamples were exposed to the elements;
- One concrete Aggregate Sample (C3) shows an increase in leachability with increasing time the subsamples were exposed to the elements.

Research was undertaken to help understand the reason for these varying trends. Aluminium does not form a common carbonate rock forming mineral (Deer, Howie & Zussman, 1992). Therefore, it would not be anticipated to precipitate out within a carbonate mineral on the surface of concrete when carbonation occurs. If aluminium is leached from a substance at around neutral pH, it will be stable as an aluminium hydroxide (Brookins, 1988) (such as Gibbsite and Bayerite), which are generally insoluble and would be expected to be precipitate and not be present within a leachate. At higher pH more typical from concrete aggregate leachate, it will tend to form the negative AlO_2^- ion (Brookins, 1988). This ion would be expected to be present within leachate as it would not adsorb onto negatively charged sorption sites on carbonated surfaces. Therefore, whether aluminium is soluble or precipitates as the process of carbonation progresses is considered likely to vary with pH. The leachability of aluminium may vary by mineral types in ballast rocks, and the amount of tricalcium aluminate added to the cement mix (in concrete aggregates), which may be highly variable across the natural aggregate and concretes samples and subsamples. This may contribute to the variable leachate trends identified for aluminium for the different aggregate samples.

3.2.6 *Cadmium, Lead, Mercury, Selenium*

In all solid subsamples, cadmium (<0.1 to 0.9 mg/kg), lead (9 to 23 mg/kg), mercury (<0.1 mg/kg in all cases) and selenium (<1 mg/kg in all cases), were recorded at low or non-detect concentrations. The maximum solid lead concentration was over an order of magnitude below the proposed lead S-PLV of 310 mg/kg.

These metals were not detected above laboratory method detection limits in concrete or natural aggregate leachate in any of the 82 leachate subsamples and hence no proposed PLV exceedances were identified.

3.3 Metalloids

Antimony was not detected in any of the solid subsamples (<1 mg/kg). Arsenic solid concentrations were between 5.3 and 10.9 mg/kg, in all cases below the arsenic S-PLV of 40 mg/kg.

Antimony and arsenic concentrations were low in all 82 leachate subsamples, with no exceedances of proposed PLVs identified. In the A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding), antimony was detected in three aggregate samples at a maximum concentration of 0.040 mg/kg and arsenic was recorded in two aggregate samples at a maximum concentration of 0.041 mg/kg. Because of the low concentrations reported, no assessment of leachability trends can be made.

As shown in Figure IV13 and IV14 in Appendix IV, the leachability of antimony and arsenic did not clearly increase or decrease with the amount of time subsamples were exposed to the elements. At 0, 3 and 6 weeks exposure time, a similar number of detections, and a similar range of leachable concentrations, were measured for each aggregate sample.

Antimony would be expected to form negative or neutral species in groundwater (Filella et al, 2002) and arsenic would be expected to form negative species in groundwater (Adeloju et al, 2021). Both these elements typically forming hydroxide and oxide species. Therefore, neither of these metalloids would be expected to adsorb onto negatively charged sites that are present on carbonated aggregate surfaces and natural minerals present at the pH measured. Antimony and arsenic leachability would therefore be expected to be unchanged by the carbonation processes.

3.4 Inorganics

3.4.1 Sulphate

Variable total sulphate concentrations were measured in solid subsamples. In concrete aggregate samples, values between 5.4 and 434 mg/kg were recorded and in the two natural aggregate samples, values of 85.2 mg/kg (B1) and 316 mg/kg (B2) were recorded.

For the A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding), which were stored outdoors in stockpiles for <3 days to 3 weeks at the aggregate producer prior to sampling, leachable sulphate concentrations for the natural aggregate samples (33 to 53 mg/kg) were less than those for the A1, C1 and C2 concrete Aggregate Samples (237 to 4,270 mg/kg). However, in the C3 concrete Aggregate Sample that had been left outdoors for 6 months prior to sampling, lower leachable sulphate concentrations were measured (21 to 27 mg/l) than the natural aggregates. This may indicate a reduction in the leachable sulphate concentration over the 6 months of stockpiling caused by the carbonation process or could relate to compositional variability in the concrete compared to the other concrete aggregate samples.

Sulphate leachate subsamples showed variability of up to an order of magnitude between duplicates, with differences of up to 200 % measured. For example, the A2 Leachate Subsample duplicates for the C3 Aggregate Sample recorded results of 109 and 279 mg/kg. Two potential anomalous leachate subsample results were identified and investigated with the laboratory:

- The concrete C1 Aggregate Sample A2 Leachate Subsample recorded original sulphate concentrations of 4,430 mg/kg and 384 mg/kg in it paired duplicates. This first anomalous value reduced to 425 mg/kg upon re-testing, closer to its paired duplicate value.

- The concrete C1 Aggregate Sample A3 Leachate Subsample recorded original sulphate concentrations of 14,300 mg/kg and 336 mg/kg in its paired duplicates. The first anomalous value reduced to 925 mg/kg upon re-testing, closer to its paired duplicate value.

Both anomalous results passed QA/QC tests in the laboratory. The original anomalous results may relate to laboratory error and have been excluded from the data analysis.

The leachability of sulphate, as shown in Figure IV15 in Appendix IV, shows different trends with the amount the material is crushed or ground prior to leaching for different aggregate samples. For example, for the leachate subsamples which were leached and analysed directly after preparation:

- In the A1 concrete Aggregate Sample the leachable sulphate concentration in the tested as received (no crushing or grinding) leachate subsample (563 to 818 mg/kg) was similar to that measured in the crushed to 95 % < 4 mm and ground to <0.2 mm leachate subsamples (530 to 849 mg/kg).
- In the B1 and B2 natural Aggregate Samples the leachable sulphate concentration increased the more that the material was crushed/ground. For example, the B1 Aggregate Sample recorded 42 to 45 mg/kg leachable sulphate in the tested as received (no crushing or grinding) leachate subsample, 262 to 302 mg/kg in the crushed to 95 % <4 mm leachate subsample and 422 to 436 mg/kg in the ground to <0.2 mm leachate subsample.
- In the C1, C2 and C3 concrete Aggregate Samples the sulphate concentration decreased the more the material was crushed/ground. For example, the C1 Aggregate Sample recorded 237 to 354 mg/kg leachable sulphate in the tested as received (no crushing or grinding) subsample, 228 to 246 mg/kg in the crushed to 95 % <4 mm subsample and 17 to 18 mg/kg in the ground to <0.2 mm subsample.

Inconsistent trends in leachable sulphate concentration were also seen with the amount of time leachate subsamples were left exposed to the elements. Exposure time had no clear effect on leachable sulphate concentration for the A1, B1, B1 or C1 Aggregate Samples. For the C2 Aggregate Sample, concentrations of leachable sulphate reduced with exposure time: for the tested as received (no crushing or grinding) subsamples, leachable sulphate concentrations reduced from 2,150 and 4,270 mg/kg at 0 weeks exposure time to 533 and 867 mg/kg at 6 weeks exposure time. For the C3 Aggregate Sample, leachable sulphate increased with exposure time: for the crushed to 95 % <4 mm subsamples, leachable sulphate concentrations increased from 7 to 16 mg/kg at 0 weeks exposure time to 169 to 194 mg/kg at 6 weeks exposure time. Exceedances of the sulphate leachate PLV-A were identified in 2 out of 36 leachate subsamples at 0 weeks exposure time, in 5 out of 36 subsamples at 3 weeks exposure time and in 1 out of 36 subsamples at 6 weeks exposure time.

The reason for these varying effects of grain size, laboratory preparation method and time exposed to the elements are unclear.

3.4.2 *Chloride*

Chloride was recorded in solid subsamples between 21 and 56 mg/kg. The A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding) recorded leachable chloride concentrations between <3 and 11 mg/kg for natural aggregate samples and between 4 and 49 mg/kg for concrete aggregate samples. No exceedances of the chloride PLVs were identified for any of the leachate subsamples.

For the Site C concrete samples a decrease in chloride leachability was observed relative to the amount of time the concrete spent outdoors in a stockpile, prior to sampling by Geosyntec. For example, in the A1 Leachate Subsamples analysed directly after preparation (with no crushing or grinding), leachable chloride values decreased from 46 to 49 mg/kg (C1 Aggregate Sample, <3 days in stockpile) to 39 to 44 mg/kg (C2 Aggregate Sample, 1 week in stockpile) to 18 to 20 mg/kg (C3 Aggregate Sample, 6 months in stockpile).

The leachability of chloride in all aggregate samples increased the more the samples were crushed or ground, as observed in Figure IV16 in Appendix IV. For example, in the C1 concrete aggregate sample, for those samples analysed directly after preparation, the tested as-received (no crushing or grinding) leachate subsample recorded chloride at 46 and 49 mg/kg, in the 95 % crushed to <4 mm subsample chloride concentrations of 52 and 61 mg/kg were recorded, and in the ground to <0.2 mm subsample, chloride concentrations of 66 and 68 mg/kg were recorded. This suggests that chloride is effectively liberated from any mineral it is present within, allowing it to be later leached, through the crushing process.

Also, for all aggregate samples, the leachability of chloride decreased with the time that subsamples were exposed to the elements outdoors prior to sample preparation and leachate analysis. For example, in the C3 concrete Aggregate Sample in the crushed to 95 % < 4 mm leachate subsample, 28 and 29 mg/kg chloride was recorded after 0 weeks exposure, 14 and 16 mg/kg chloride was recorded after 3 weeks exposure, and 11 and 12 mg/kg chloride was recorded after 6 weeks exposure.

The trends seen for chloride with increasing exposure time to the elements are similar to those observed for chromium, calcium, barium and potassium. Chloride forms a negative ion in groundwater and would not be expected to adsorb onto negatively charged carbonate and mineral surfaces the same way that positively charged metal ions do. The reduction of chloride could be due to the precipitation of small amounts of chloride rich apatite or carbonate-apatite in the carbonated layer (Deer, Howie & Zussman, 1992) when it forms on concrete and natural aggregates.

3.4.3 *Fluoride and Organic Carbon*

Fluoride was not detected in solid subsamples (<0.3 mg/kg) and was recorded below laboratory method detection limits (<3 mg/kg) or just above (3 to 5 mg/kg) in leachate subsamples for all aggregate samples. A single exceedance of the leachable fluoride PLV-A was recorded in the B1 natural Aggregate Sample in one duplicate of the C1 Leachate Subsample (ground to < 0.2 mm, analysed after 0 weeks exposure time to the elements), where it was recorded at 5 mg/kg. Due to the low recorded fluoride leachate concentrations no interpretation on trends can be made.

Total Organic Carbon (TOC) concentrations in concrete and total aggregates were between 0.15 and 0.79 % in solid subsamples. Dissolved Organic Carbon (DOC) in leachate subsamples was between <20 and 100 mg/kg. Recorded TOC values were below the S-PLV, and recorded DOC values were below the PLV-A, in all subsamples.

The leachability of DOC is shown in Figure IV17 in Appendix IV. No clear trends in DOC concentration were identified with regard to time that aggregate was left in the stockpile at the aggregate producer prior to sampling by Geosyntec, or the amount that the aggregate was crushed/ground by the laboratory prior to analysis, or the time the leachate subsamples were exposed to the elements post laboratory preparation and prior to analysis.

3.5 Hydrocarbons

Hydrocarbons were detected in all four concrete aggregate solid subsamples, as detailed in Table III-2 in Appendix III. Polycyclic aromatic hydrocarbons (PAH) were detected in three concrete aggregate solid subsamples. In one of the concrete aggregate samples (C2) a total PAH (17 including coronene) concentration of 7.05 mg/kg was recorded, exceeding the S-PLV of 2 mg/kg. This compares to 4 exceedances of the S-PLV out of 62 concrete aggregate samples in the National and Industrial datasets (summarised in Section 2.3.9 of the main End-of-Waste technical report).

In the two natural aggregates solid subsamples, very low concentrations of three PAHs were detected in one of the aggregate samples (B2) and may represent low levels of contamination in the source soils. No PAH concentrations in natural aggregate samples exceeded the S-PLV.

Leachable concentrations of individual PAHs were measured in all aggregate samples, including the one natural aggregate sample (B1) in which no total PAH was measured in the solid subsample. Table III-4 and Figures IV18 to IV23 in Appendix IV show that the amount of individual PAH species or total PAHs leaching from aggregate samples does not clearly vary with the time that the aggregate spent outdoors in stockpiles at the aggregate producer prior to sampling by Geosyntec, or the amount of grinding/crushing that has taken place prior to leach testing, or the amount of time that subsamples were exposed to the elements post sample preparation and pre-leach testing. The highest leachable total PAH concentrations were observed in the A1 Leachate Subsample taken from the C2 concrete Aggregate Sample (0.16 mg/kg), and the highest concentrations in natural aggregate were observed in the B3 Leachate Subsample taken from the B2 natural Aggregate Sample (0.00503 mg/kg). Although higher PAH concentrations were detected in concrete aggregates compared to natural aggregates, measured concentrations were variable and likely represent differing levels of low-level contamination in the aggregate samples.

Detectable total petroleum hydrocarbon (TPH) >C10-C44 concentrations (taken as an approximate "Mineral Oil" measure) were measured in 3 of the 4 concrete aggregate sample solid subsamples (A1, C1 and C2). In these 3 samples, TPH >C10-C44 concentrations were recorded between 107 and 519 mg/kg, exceeding the S-PLV of 50 mg/kg. Although this represents a 75 % exceedance rate of the Mineral Oil S-PLV in the concrete samples taken for this study it is important to remember this is for a small sample set. This high exceedance rate is not observed within the Industry and National Datasets (see Section 2.3.9 of the main End-of-Waste technical report), for which just 14 out of a total of 105 samples exceeded the S-PLV, an exceedance rate of 13 %.

No detectable TPH was identified in any of the natural aggregate samples.

No leachable TPH fractions were identified in any of the concrete aggregate samples, indicating that the hydrocarbon fractions present in the concrete aggregates in the current study were not readily leachable.

Detectable total concentrations of other hydrocarbons (semi-volatile organic compounds (SVOCs), phenol and BTEX) were only observed in concrete aggregate samples. The only BTEX compound detected was o-xylene, at 0.011 mg/kg in concrete Aggregate Sample C1. Resorcinol was the only phenol group compound detected and was recorded at 0.05 mg/kg and 0.01 mg/kg in concrete Aggregate Samples C1 and C2 respectively. Total BTEX and phenol concentrations were below the respective S-PLVs. No BTEX or phenol compounds were detected in any of the leachate subsamples.

Bis(2-ethylhexyl)phthalate (an SVOC) and high chain length aliphatic or aromatic hydrocarbons (either as SVOC tentatively identifiable compounds or with TPH hydrocarbon bands) were identified in all the concrete aggregate samples, which may indicate the presence of additives included in the concrete during its production. Other identified SVOCs detailed in Table III-2 are considered likely to represent less common additive mixtures or very low levels of contamination within the aggregate. No SVOCs were detected above laboratory method detection limits in any of the leachate subsamples.

4 CONCLUSIONS

The key conclusions identified from this work are:

- Crushing and grinding of aggregate samples in the laboratory prior to analysis creates fresh mineral surfaces and increases the ratio of surface area to volume of grains. Leachable concentrations were greater in samples that had been crushed or ground for total chromium, chromium VI, barium, calcium, copper, molybdenum, nickel, potassium and chloride. A preparation procedure that includes crushing or grinding could therefore lead to an overestimation of leachable concentrations in Recycled Aggregate. To obtain representative estimates of leachability, it is recommended that aggregate samples are tested “as received” by a laboratory and not crushed or ground prior to analysis.
- pH of leachate from concrete and natural aggregates is likely to reduce over time as an aggregate in a stockpile is exposed to the elements (rain and the atmosphere), which promotes carbonation of particle surfaces. In the laboratory trials, a drop of pH of approximately 1 pH unit was measured over a period of 6 weeks exposure time to the elements. When comparing the pH of leachate from samples collected from producer stockpiles as part of this study, compositional variation of the concrete was identified to be the main driver for pH readings

in concrete, and the results with regard to stockpile age were less clear. There is no proposed PLV for pH.

- Leachable concentrations of chromium, chromium VI, chloride, barium, calcium, potassium, copper, molybdenum, nickel and zinc from aggregate samples decreased with the time that leachate subsamples were exposed to the elements in the laboratory trials. Reduction in leachability is likely linked to mineral precipitation and sorption of metals related to the carbonisation process. A similar trend was not observed with regard to samples taken from stockpiles at aggregate producer facilities, except for chloride.
- Leachable concentrations of vanadium from aggregate samples were identified to increase the longer that leachate subsamples were exposed to the elements in the laboratory trials. However, the vanadium concentration in all leachate subsamples remained below the proposed PLVs.
- Low levels of antimony and arsenic were identified in solid subsamples and leachate subsamples, with no exceedances of proposed PLVs identified. No observable pattern in leachate concentrations for these determinands were identified with material type, sample preparation or exposure time.
- Aluminium was identified at elevated concentrations in solid samples and leachate samples, likely related to the presence of natural minerals in ballast material or concrete additives. There is no proposed PLV for aluminium. No observable patterns in leachate concentrations for aluminium were identified with material type, sample preparation or exposure time.
- Total Organic Carbon and Dissolved Organic Carbon were not identified at concentrations exceeding the proposed S-PLV or PLVs, respectively. No observable pattern in leachate concentrations were identified with material type, sample preparation or exposure time.
- Leachable sulphate concentrations for natural aggregates were not identified above proposed PLVs, but they were for concrete aggregates (refer to following point). No observable patterns in leachate concentrations were identified with material type, sample preparation or exposure time. Sulphate concentrations were identified to vary between duplicate samples by up to 200 %, the reason for which is not clear.
- Exceedances of proposed PLVs in leachate were identified for three determinands: fluoride, sulphate and chromium:
    - Only one exceedance of the fluoride PLV-A value was measured for a natural aggregate subsample that was ground to a fine powder and leached directly after preparation, out of a total of 84 leachate subsamples (including duplicates) for the 6 aggregate samples. This value was below the fluoride PLV-B.
    - For chromium, exceedances of the PLVs were only identified from concrete aggregate samples, and the more that a subsample was ground/ crushed prior to analysis the higher the chromium concentration recorded. Increasing exposure time to the elements

  resulted in fewer exceedances of the chromium PLV in leachate subsamples, with no exceedances of PLVs observed in leachate from samples exposed to the elements for 6 weeks. In total, 19 exceedances of the PLV-A and 4 exceedances of the PLV-B were identified across a total of 56 leachate subsamples (including duplicates) for the 4 concrete aggregate samples. Failures of PLV-A were identified in 3 out of 4 concrete aggregate samples and failures of PLV-B were identified in 2 concrete aggregate samples. Exceedances of PLV-B were only identified in ground samples.

  - For sulphate, PLV exceedances were observed in 3 out of 4 concrete aggregate samples and neither of the 2 aggregate samples. In subsamples exposed to the elements for 6 weeks, only a single exceedance of the sulphate PLV-A was identified. In total, 8 exceedances of the PLV-A and 2 exceedances of the PLV-B were identified across a total of 56 leachate subsamples (including duplicates) for the 4 concrete aggregate samples.

- Based on the above, determinand leachate concentrations in aggregate samples which are tested “as-received” by the laboratory (not crushed or ground prior to analysis) are more likely to be below PLVs as compared to leachate from crushed or ground samples. Laboratory experiments suggest that the potential for leachate concentrations to exceed PLVs may be reduced by exposing aggregate stockpiles to the elements for a period of weeks post-crushing, and prior to testing.

- TPH analysis on solid samples reported Mineral Oil concentrations above the S-PLV in 3 out of 4 concrete aggregate samples. However, no petroleum hydrocarbons were detected above laboratory method detection limit in the respective leachate samples. It is also noted that 14 out of 105 concrete samples from the National and Industry Datasets (summarised in the main End-of-Waste technical report) exceed the S-PLV. The data suggests that TPH may often be detected in Recycled Aggregate produced from concrete, which may be due to commonly used additives, and that there may be potential for frequent exceedances of the S-PLV for Mineral Oil. With this in mind, it is recommended that a higher S-PLV is permitted for Mineral Oil, provided it is shown through leach testing that the Mineral Oil is not leachable.

- No petroleum hydrocarbons were detected in natural aggregate solid or leachate samples.

- Individual PAH compounds were identified in 3 out of 4 concrete aggregate solid samples and in 1 out of 2 natural aggregate samples. An exceedance of the total PAH S-PLV was only identified in a one concrete aggregate sample. This compares to 4 exceedances of the S-PLV out of 62 concrete aggregate samples in the National and Industrial datasets (summarised in the main End-of-Waste technical report). Trace levels of individual PAHs were detected in all leachate subsamples, with no clear trends observed with regard to subsample preparation (crushing/grinding) or with regard to time of exposure to the elements.

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A P P E N D I X

I

Photographic Log of Site Visits

GEOSYNTEC CONSULTANTS

Photographic Record

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 1

Date: 22 November 2022

Site: A

Comments: Site A sampled 6F2 concrete aggregate stockpile. Sample A1

Photograph 2

Date: 7 July 2022

Site: A

Comments:
Sample A1.
6F2 Concrete aggregate,
Pieces of concrete 35 mm and less.

GEOSYNTEC CONSULTANTS

Photographic Record

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 3 **Date:** 22 November 2022 **Site:** B **Comments:** Site B. Sampled 10mm natural aggregate stockpile approximately 1 week in age. Sample B.1	
Photograph 4 **Date:** 22 November 2022 **Site:** B	

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

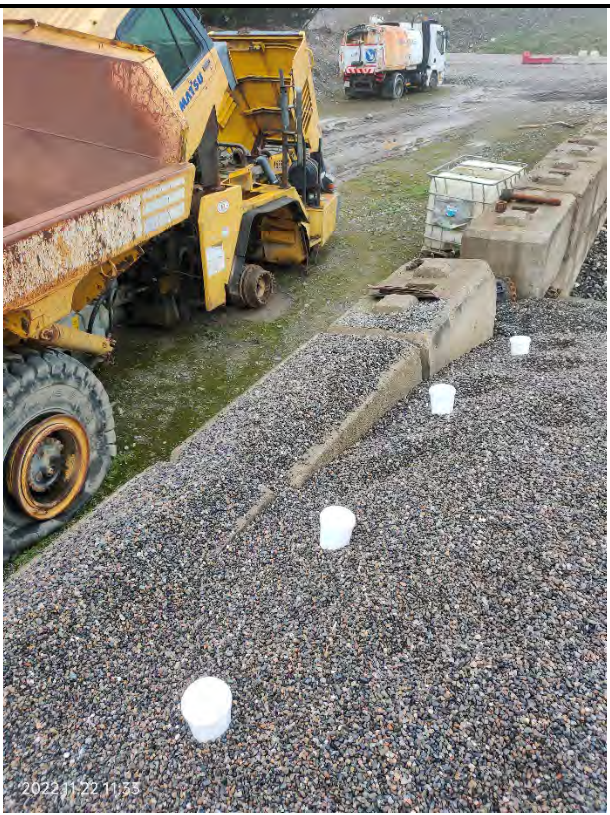
Comments:
Sample B.1.
10mm natural aggregate.

Photograph 5

Date: 22 November 2022

Site: B

Comments: Site B.
Sampled 10mm natural aggregate stockpile approximately 4 weeks in age.
Sample B.2



Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 6

Date: 22 November 2022

Site: B

Comments:
Sample B.2
10mm natural aggregate.


2022.11.22 22:41

Photograph 7

Date: 22 November 2022

Site: C

Comments: Site C.
Sampled 30mm concrete aggregate stockpile, less than 3 days in age.
Sample C.1


2022.11.22 14:20

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 8	 2022.11.22 14:29
Date: 22 November 2022	
Site: C	
Comments: Sample C.1 30mm concrete aggregate.	

Photograph 9	 2022.11.22 14:51
Date: 22 November 2022	
Site: C	
Comments: Site C. Sampled 30mm concrete aggregate stockpile, less than 1 week in age. Sample C.2	

Photographic Record

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 10 **Date:** 22 November 2022 **Site:** C **Comments:** Sample C.2 30mm concrete aggregate.	
Photograph 11 **Date:** 22 November 2022 **Site:** C **Comments:** Site C. Sampled 30mm concrete aggregate stockpile, less than 1 week in age. Sample C.3	

GEOSYNTEC CONSULTANTS

Photographic Record

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 12 **Date:** 22 November 2022 **Site:** C **Comments:** Sample C.3 30mm concrete aggregate.	
Photograph 13 **Date:** 09 Dec 2022 **Laboratory** **Comments:** Laboratory subsamples (A2, A3, B2 and B3) prepped for analysis and left outside for 3 or 6 weeks.	

Client: EPA	**Project Number:** GCU0146045
Site Name: -	**Site Location:** -

Photograph 14

Date: 11 Jan 2023

Laboratory -

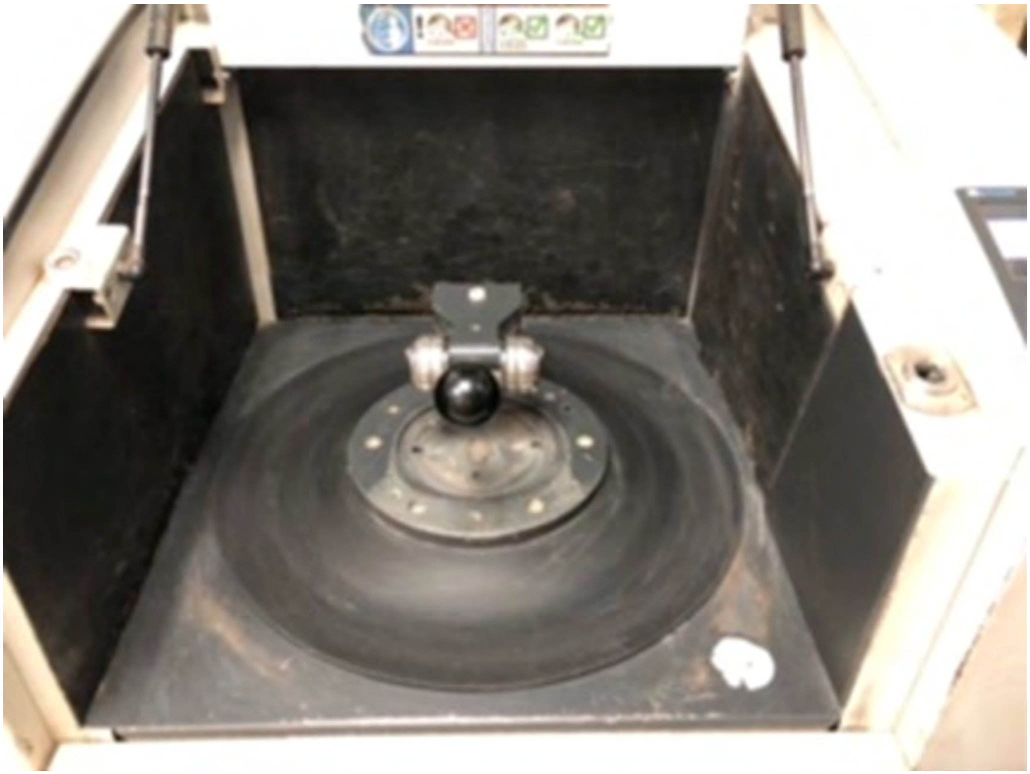
Comments: Laboratory draw crusher used to crush the B1, B2 and B3 subsamples to 95 % < 4mm in line with BS 12457.

Photograph 15

Date: 11 Jan 2023

Laboratory

Comments: Retsch Grinding Machine (0.2 mm) used to grind the C1 subsamples.



APPENDIX

II

Recycled Aggregate Producer Questionnaires

Geosyntec consultants

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D09 W8DT
Tel: 01 653 3170
www.geosyntec.eu

EPA Aggregate Sampling Site Visit Questionnaire

Site Details	
Site Name	**Site A**
Facility Type	**Mixed Use**
Operations Undertaken on Site:	**Civil Engineering, Plant hire, material recycling, haulage**

Geosyntec are undertaking a study on behalf of the EPA on the leachability of granular recycled aggregate materials. We plan to attend your facility (and two other locations) to obtain a total of six small samples from aggregate stockpiles for analysis. From your facility we request to take two 5 kg composite samples from different stockpiles.

The below list summarises the materials we are interested in sampling. Please indicate if you have any of the below materials available:

- Concrete Aggregate
  - Scheduled to be crushed to grade this week ☐
  - Crushed to grade around one week ago ☐
  - Crushed to grade around one month ago ☒
  - Crushed to grade around six months ago ☐
- Natural Aggregate
  - Crushed to grade less than a week ago ☐
  - Crushed to grade around one month ago ☐

If none of the above stockpiles are present at your facility, please detail in the space below any similar potentially suitable materials you have available for sampling:

Total number of potentially appropriate stockpiles for sampling available: 1

We request that you fill in and return to us the requested information on the following page for each potentially appropriate stockpile prior to the scheduled sampling date. This will help us make sure that the stockpiles chosen are suitable for our study. If this is not possible our sampling engineer will go through these questions with your operators on-site prior to sampling. If you have more than two appropriate stockpiles, please fill in multiple copies of the questionnaire.

Please nominate at least two aggregate stockpiles for sampling.

Question	A	B
What material is the stockpile? (e.g. concrete, natural aggregate, etc.)	Concrete	
What grade has the material been crushed to? (e.g. 10 mm, 4 mm, 6F2, 2C1, unspecified, etc.)	6F2 (75 mm and down)	
When did the crushing take place? (e.g. in the last week, 1 month ago, etc.)	2-3 weeks	
Does the aggregate have any of the following impurities, if so, please state the percentage? o Wood o Soil o Organic material o Plastic o Metal o Tarmacadam/ asphalt o Ash, clinker o Bricks, tiles, concrete o Other (please state)	Site contact stated that there may be "minor" impurities with maybe some rebar.	
Where was the source(s) of the stockpile material? Please give location and nature of source operations if known.	Concrete slab from an old telecommunications storage yard in Dublin.	
For concrete derived aggregate, do you know what year the original concrete was cast?	Unknown	
For concrete aggregates are any former coatings or epoxy resins visible in the aggregate?	Site contact states that none is obvious.	
For natural aggregates please state what rock type the aggregate comprises of? Please give Geological Survey of Ireland geological domain if known.	Not Applicable	
Has the aggregate been washed, if so, please detail the process? (e.g. washing with cold water, surfactant, etc.)	No washing	
Has the aggregate been treated or segregated in any way, if so, please detail the process? (e.g. screening, hand picking, use of magnets. etc.)	A wind sucker is present on the concrete crusher to remove plastic and timber	
What is the intended use of the aggregate? (e.g. road construction, void filling, temporary hard standing, haul/ forestry road, etc.)	Temporary hard standing	
Other pertinent information		

Geosyntec
consultants

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EPA Aggregate Sampling Site Visit Questionnaire

Site Details	
Site Name:	**Site B**
Facility Type	**Non-Hazardous Construction and Demolition Waste Recovery Facility. Plus, inert waste landfill facility.**
Operations Undertaken on Site:	**Soil washing and sorting. Infilling of inert landfill with washed and sorted waste. Open at 8am and closes 5pm**

Geosyntec are undertaking a study on behalf of the EPA on the leachability of granular recycled aggregate materials. We plan to attend your facility (and two other locations) to obtain a total of six small samples from aggregate stockpiles for analysis. From your facility we request to take two 5 kg composite samples from different stockpiles.

The below list summarises the materials we are interested in sampling. Please indicate if you have any of the below materials available:

- Concrete Aggregate
  - Scheduled to be crushed to grade this week ☐
  - Crushed to grade around one week ago ☐
  - Crushed to grade around one month ago ☐
  - Crushed to grade around six months ago ☐
- Natural Aggregate
  - Crushed to grade less than a week ago ☒
  - Crushed to grade around one month ago ☒

If none of the above stockpiles are present at your facility, please detail in the space below any similar potentially suitable materials you have available for sampling:

Total number of potentially appropriate stockpiles for sampling available: ___2___

We request that you fill in and return to us the requested information on the following page for each potentially appropriate stockpile prior to the scheduled sampling date. This will help us make sure that the stockpiles chosen are suitable for our study. If this is not possible our sampling engineer will go through these questions with your operators on-site prior to sampling. If you have more than two appropriate stockpiles, please fill in multiple copies of the questionnaire.

Please nominate at least two aggregate stockpiles for sampling.

Question	**A**	**B**
What material is the stockpile? **(e.g. concrete, natural aggregate, etc.)**	Natural Aggregate	Natural Aggregate
What grade has the material been crushed to? **(e.g. 10 mm, 4 mm, 6F2, 2C1, unspecified, etc.)**	10 mm	10 mm
When did the crushing/ stockpiling take place? (e.g. in the last week, 1 month ago, etc.)	Less than 7 days ago	Around 1 month ago
Does the aggregate have any of the following impurities, if so, please state the percentage? o **Wood** o **Soil** o **Organic material** o **Plastic** o **Metal** o **Tarmacadam/ asphalt** o **Ash, clinker** o **Bricks, tiles, concrete** o **Other (please state)**	<1 to 2% max bricks, tiles, concrete Occasional glass	<1 to 2% max bricks, tiles, concrete Occasional glass
Where was the source(s) of the stockpile material? Please give location and nature of source operations if known.	Mostly non-hazardous waste material for Made Ground.	Mostly non-hazardous waste material for Made Ground.
For concrete derived aggregate, do you know what year the original concrete was cast?	NA	NA
For concrete aggregates are any former coatings or epoxy resins visible in the aggregate?	NA	NA
For natural aggregates please state what rock type the aggregate comprises of? Please give Geological Survey of Ireland geological domain if known.	Most from Dublin area (90%), but from all over the country.	Most from Dublin area (90%), but from all over the country.
Has the aggregate been treated or segregated in any way, if so, please detail the process? (e.g. screening, hand picking, use of magnets. etc.)	Material screened to remove large materials; then clay and bigger stones broken up; then material washed	Material screened to remove large materials; then clay and bigger stones broken up; then material washed
Has the aggregate been washed, if so, please detail the process? (e.g. washing with cold water, surfactant, etc.)	Material washed in suspension, then individual grains sorted and scrubbed. Silt and sand separate out with flocculant. The settled mud is put into a filter press.	Material washed in suspension, then individual grains sorted and scrubbed. Silt and sand separate out with flocculant. The settled mud is put into a filter press.
What is the intended use of the aggregate? (e.g. road construction, void filling, temporary hard standing, haul/ forestry road, etc.)	All materials get used in the inert landfill. The location in the landfill is dependent on chemical testing.	All materials get used in landfill. The location in the landfill is dependent on chemical testing.

Question	A	B
Other pertinent information		

Geosyntec consultants

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EPA Aggregate Sampling Site Visit Questionnaire

Site Details	
Site Name:	**Site C**
Facility Type	**Licensed Landfill Facility, Recycling and Recovery Facility.**
Operations Undertaken on Site:	**Recycle and recover inert construction and demolition material.** **Don't do landfilling at the facility.**

Geosyntec are undertaking a study on behalf of the EPA on the leachability of granular recycled aggregate materials. We plan to attend your facility (and two other locations) to obtain a total of six small samples from aggregate stockpiles for analysis. From your facility we request to take two 5 kg composite samples from different stockpiles.

The below list summarises the materials we are interested in sampling. Please indicate if you have any of the below materials available:

- Concrete Aggregate
    - Scheduled to be crushed to grade this week ☒
    - Crushed to grade around one week ago ☒
    - Crushed to grade around one month ago ☐
    - Crushed to grade around six months ago ☒
- Natural Aggregate
    - Crushed to grade less than a week ago ☐
    - Crushed to grade around one month ago ☐

If none of the above stockpiles are present at your facility, please detail in the space below any similar potentially suitable materials you have available for sampling:

Total number of potentially appropriate stockpiles for sampling available: 2

We request that you fill in and return to us the requested information on the following page for each potentially appropriate stockpile prior to the scheduled sampling date. This will help us make sure that the stockpiles chosen are suitable for our study. If this is not possible our sampling engineer will go through these questions with your operators on-site prior to sampling. If you have more than two appropriate stockpiles, please fill in multiple copies of the questionnaire.

Please nominate at least two aggregate stockpiles for sampling.

Question	A	B
What material is the stockpile? **(e.g. concrete, natural aggregate, etc.)**	Concrete	Concrete
What grade has the material been crushed to? **(e.g. 10 mm, 4 mm, 6F2, 2C1, unspecified, etc.)**	30mm	100mm (4 inch)
When did the crushing take place? (e.g. in the last week, 1 month ago, etc.)	1 week to 6 months ago Stockpile younger at front and older at back.	Fresh to 6 months ago. Stockpile younger at front and older at back.
Does the aggregate have any of the following impurities, if so, please state the percentage? o **Wood** o **Soil** o **Organic material** o **Plastic** o **Metal** o **Tarmacadam/ asphalt** o **Ash, clinker** o **Bricks, tiles, concrete** o **Other (please state)**	Different grades of accepting: 1.Demolition Grade – will take with limited plastics and wiring, <5% of load 2.Concrete with rebar and mesh 3.Clean Concrete 4.Limited Oversized Concrete Clay and concrete mixed together not accepted. Concrete obtained from civil contractors from footpaths, slabs likely to have included hardcore stuck to the base when crushed.	Different grades of accepting: 1.Demolition Grade – will take with limited plastics and wiring, <5% of load 2.Concrete with rebar and mesh 3.Clean Concrete 4.Limited Oversized Concrete Clay and concrete mixed together not accepted. Concrete obtained from civil contractors from footpaths, slabs likely to have included hardcore stuck to the base when crushed.
Where was the source(s) of the stockpile material? Please give location and nature of source operations if known.	Construction and Demolition., Mostly Dublin and Wicklow areas	Construction and Demolition. Mostly Dublin and Wicklow areas
For concrete derived aggregate, do you know what year the original concrete was cast?	No information available	No information available
For concrete aggregates are any former coatings or epoxy resins visible in the aggregate?	Sometimes paint, dye or coatings are visible	Sometimes paint, dye or coatings are visible
For natural aggregates please state what rock type the aggregate comprises of? Please give Geological Survey of Ireland geological domain if known.	NA	NA
Has the aggregate been treated or segregated in any way, if so, please detail the process? (e.g. screening, hand picking, use of magnets. etc.)	Crushers, screeners and wind blowers are used to make the correct product. Wind blowers will remove light fines and plastics.	Crushers, screeners and wind blowers are used to make the correct product. Wind blowers will remove light fines and plastics
Has the aggregate been washed, if so, please detail the process? (e.g. washing with cold water, surfactant, etc.)	No	No

Question	A	B
What is the intended use of the aggregate? (e.g. road construction, void filling, temporary hard standing, haul/ forestry road, etc.)	Haul roads, access roads, hardstanding areas, yards	Haul roads, access roads, hardstanding areas, yards
Other pertinent information		

APPENDIX

III

Summary Tables of Results

Table III-1 - Total Analysis Summary, Inorganics and Metals

Sample ID		**A.1.6FP.3W**	**B.1.10.1WK**	**B.2.10.4WK**	**C.1.30.3DAY**	**C.2.30.1WK**	**C.3.30.6MONTH**
Site		**A**	**B**	**B**	**C**	**C**	**C**
Sample		**A1**	**B1**	**B2**	**C1**	**C2**	**C3**
Aggregate Material		**Concrete**	**Natural**	**Natural**	**Concrete**	**Concrete**	**Concrete**
Aggregate Size		**6FP**	**<10mm**	**<10mm**	**<30mm**	**<30mm**	**<30mm**
Time in Stockpile		**3 weeks**	**1 week**	**4 weeks**	**<3 days**	**1 week**	**6 months**
Determinand	**Unit**						
Aluminium	mg/kg	4300	4080	3860	6270	7510	12300
Antimony	mg/kg	<1	<1	<1	<1	<1	<1
Arsenic	mg/kg	8	10.9	8.2	7.6	8.6	5.3
Barium	mg/kg	66	32	40	51	54	45
Cadmium	mg/kg	0.5	0.9	0.5	0.4	0.4	<0.1
Calcium	mg/kg	244000	196000	190000	233000	153000	97500
Chromium	mg/kg	24.1	29.2	28.8	27.3	35.5	48.4
Copper	mg/kg	13	10	14	20	17	35
Lead	mg/kg	23	11	10	9	12	9
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	mg/kg	1.5	1.9	2.2	1.4	1.8	1.9
Nickel	mg/kg	15.6	14.5	15.4	16.1	19.2	24.8
Potassium	mg/kg	964	510	478	859	1040	1170
Selenium	mg/kg	<1	<1	<1	<1	<1	<1
Vanadium	mg/kg	17	15	15	24	27	34
Zinc	mg/kg	57	55	44	42	49	56
Natural Moisture Content	%	10.2	3.4	3.7	5.9	7.9	6.3
Chloride	mg/kg	31	31	21	42	56	24
Fluoride	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Hexavalent Chromium	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Sulphate as SO4 (2:1 Ext)	g/l	0.217	0.0426	0.158	0.0053	0.307	0.0027
Sulphate as SO4	mg/kg	434	85.2	316	10.6	614	5.4
Total Organic Carbon	%	0.49	0.23	0.79	0.15	0.66	0.09
pH	pH units	11.5	9.23	9.3	12.3	11.7	12.5

Table III-2 - Total Analysis Summary, Detectable Hydrocarbons

Sample ID		**A.1.6FP.3W**	**B.1.10.1WK**	**B.2.10.4WK**	**C.1.30.3DAY**	**C.2.30.1WK**	**C.3.30.6MONTH**
Site		**A**	**B**	**B**	**C**	**C**	**C**
Sample		**A1**	**B1**	**B2**	**C1**	**C2**	**C3**
Aggregate Material		**Concrete**	**Natural**	**Natural**	**Concrete**	**Concrete**	**Concrete**
Aggregate Size		**6FP**	**<10mm**	**<10mm**	**<30mm**	**<30mm**	**<30mm**
Time in Stockpile		**3 weeks**	**1 week**	**4 weeks**	**<3 days**	**1 week**	**6 months**
Determinand	**Unit**						
Polycyclic Aromatic Hydrocarbons							
Naphthalene	mg/kg	<0.04	<0.04	<0.04	<0.04	0.33	<0.04
Acenaphthene	mg/kg	<0.05	<0.05	<0.05	<0.05	0.18	<0.05
Fluorene	mg/kg	<0.04	<0.04	<0.04	<0.04	0.17	<0.04
Phenanthrene	mg/kg	<0.03	<0.03	0.04	0.12	1.39	<0.03
Anthracene	mg/kg	<0.04	<0.04	<0.04	<0.04	0.32	<0.04
Fluoranthene	mg/kg	<0.03	<0.03	0.04	0.14	1.25	<0.03
Pyrene	mg/kg	<0.03	<0.03	0.04	0.13	1.01	<0.03
Benzo(a)anthracene	mg/kg	<0.06	<0.06	<0.06	0.07	0.48	<0.06
Chrysene	mg/kg	<0.02	<0.02	<0.02	0.06	0.49	<0.02
Benzo(a)pyrene	mg/kg	<0.04	<0.04	<0.04	<0.04	0.36	<0.04
Indeno(123cd)pyrene	mg/kg	<0.04	<0.04	<0.04	<0.04	0.21	<0.04
Benzo(ghi)perylene	mg/kg	<0.04	<0.04	<0.04	<0.04	0.18	<0.04
Benzo(b)fluoranthene	mg/kg	<0.05	<0.05	<0.05	0.06	0.49	<0.05
Benzo(k)fluoranthene	mg/kg	<0.02	<0.02	<0.02	0.02	0.19	<0.02
2-Methylnaphthalene	mg/kg	0.014	<0.01	<0.01	0.074	0.055	<0.01
Semi Volatile Organic Compounds, Including Tentatively Identifiable Compounds							
Bis(2-ethylhexyl) phthalate	mg/kg	5.9	<0.1	<0.1	0.6	0.3	1
Di-n-Octyl phthalate	mg/kg	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Carbazole	mg/kg	<0.01	<0.01	<0.01	0.06	0.05	<0.01
Dibenzofuran	mg/kg	<0.01	<0.01	<0.01	0.08	0.06	<0.01
Benzyl Alcohol	mg/kg	0.6	-	-	-	-	-
o-Chloroaniline	mg/kg	0.2	-	-	-	-	-
Tridecane	mg/kg	-	-	-	0.4	-	-
Tetradecane	mg/kg	-	-	-	0.5	-	-
Phenol, 2,4-bis(1,1-dimethylethyl)-	mg/kg	-	-	-	-	-	0.1
Hexadecane	mg/kg	-	-	-	3.1	0.1	-
Dodecane, 2,6,11-trimethyl-	mg/kg	-	-	-	0.8	-	-
Hexacosane	mg/kg	-	-	-	1.8	-	-
Nonadecane	mg/kg	-	-	-	1.1	-	-
Eicosane	mg/kg	-	-	-	1.4	-	-
BTEX and Phenol							
o-Xylene	mg/kg	<0.005	<0.005	<0.005	0.011	<0.005	<0.005
Resorcinol	mg/kg	<0.01	<0.01	<0.01	0.05	0.01	<0.01
TPH CWG Fractions							
Aliphatic >C10-C12	mg/kg	11	<4	<4	19	<4	<4
Aliphatic >C16-C21	mg/kg	47	<7	<7	82	<7	<7
Aliphatic >C21-C25	mg/kg	195	<7	<7	226	<7	27
Aliphatic >C35-C44	mg/kg	41	<7	<7	19	<7	<7
Aromatic >EC21-35	mg/kg	156	<7	<7	92	83	<7
Aromatic >EC35-44	mg/kg	69	<7	<7	32	24	<7

Table III-3 - 10:1 L/S Leachate Analysis, Inorganics and Metals

Sample ID		A.1.6FP.3W - Leachate A1 (i)	A.1.6FP.3W - Leachate A1 (ii)	A.1.6FP.3W - Leachate A2 (i)	A.1.6FP.3W - Leachate A2 (ii)	A.1.6FP.3W - Leachate A3 (i)	A.1.6FP.3W - Leachate A3 (ii)
Site		**A**	**A**	**A**	**A**	**A**	**A**
Sample		**A1**	**A1**	**A1**	**A1**	**A1**	**A1**
Subsample		**A1**	**A1**	**A2**	**A2**	**A3**	**A3**
Preparation		**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**Fine Powder - D&C**	**Fine Powder - D&C**
Aggregate Material		**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
Aggregate Size		**6FP**	**6FP**	**6FP**	**6FP**	**6FP**	**6FP**
Time in Stockpile		**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**
Carbonisation Time		**0 weeks**	**0 weeks**	**3 weeks**	**3 weeks**	**6 weeks**	**6 weeks**
Determinand	**Unit**						
Aluminium	mg/kg	11.2	9.4	0.7	0.5	0.9	0.5
Antimony	mg/kg	0.04	<0.02	0.06	0.06	0.04	0.05
Arsenic	mg/kg	0.041	<0.025	<0.025	<0.025	<0.025	<0.025
Barium	mg/kg	0.22	0.2	0.18	0.1	0.09	0.07
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/kg	580	733	429	490	305	258
Chromium	mg/kg	0.151	0.131	0.138	0.179	0.075	0.05
Copper	mg/kg	<0.07	<0.07	<0.07	0.13	<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	mg/kg	<0.02	<0.02	<0.02	0.03	<0.02	<0.02
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potassium	mg/kg	237	192	131	153	75	75
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Vanadium	mg/kg	0.09	0.081	0.193	0.227	0.194	0.178
Zinc	mg/kg	<0.03	<0.03	<0.03	0.1	<0.03	<0.03
Natural Moisture Content	%	-	-	22.8	22.8	12.7	12.7
Moisture Content 105C (% Dry Weight)	%	14.3	14.3	81.4	81.4	88.7	88.7
Dry Matter Content Ratio 105°C	%	87.5	87.5				
Mass of raw test portion	kg	0.1029	0.1027				
Leachant Volume	l	0.887	0.887				
Chloride	mg/kg	5	4	<3	<3	<3	<3
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3
Hexavalent Chromium	mg/kg	0.07	<0.06	<0.06	<0.06	<0.06	<0.06
Sulphate as SO4	mg/kg	563	818	917	1010	582	432
Dissolved Organic Carbon	mg/l	3	<2	4	<2	3	<2
pH	pH units	11.3	11.2	10.3	10.1	9.88	10

Sample ID		B.1.10.1WK - Leachate A1 (i)	B.1.10.1WK - Leachate A1 (ii)	B.1.10.1WK - Leachate A2 (i)	B.1.10.1WK - Leachate A2 (ii)	B.1.10.1WK - Leachate A3 (i)	B.1.10.1WK - Leachate A3 (ii)
Site		**B**	**B**	**B**	**B**	**B**	**B**
Sample		**B1**	**B1**	**B1**	**B1**	**B1**	**B1**
Subsample		**A1**	**A1**	**A2**	**A2**	**A3**	**A3**
Preparation		**Fine Powder - D&C**	**Fine Powder - D&C**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**
Aggregate Material		**Aggregate**	**Aggregate**	**Aggregate**	**Aggregate**	**Aggregate**	**Aggregate**
Aggregate Size		**10mm**	**10mm**	**10mm**	**10mm**	**10mm**	**10mm**
Time in Stockpile		**1 Week**	**1 Week**	**1 Week**	**1 Week**	**1 Week**	**1 Week**
Carbonisation Time		**0 weeks**	**0 weeks**	**3 weeks**	**3 weeks**	**6 weeks**	**6 weeks**
Determinand	**Unit**						
Aluminium	mg/kg	4.5	2.1	4	3	2.7	2.3
Antimony	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic	mg/kg	<0.025	0.038	<0.025	<0.025	0.032	<0.025
Barium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/kg	105	98	74	89	82	76
Chromium	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	mg/kg	<0.02	0.03	<0.02	<0.02	<0.02	<0.02
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potassium	mg/kg	6	7	6	10	3	6
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Vanadium	mg/kg	0.038	0.019	0.03	0.066	0.022	0.035
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Natural Moisture Content	%	-	-	4.3	4.3	2.1	2.1
Moisture Content 105C (% Dry Weight)	%	0.3	0.3	95.8	95.8	97.9	97.9
Dry Matter Content Ratio 105°C	%	99.7	99.7				
Mass of raw test portion	kg	0.0899	0.0905				
Leachant Volume	l	0.9	0.9				
Chloride	mg/kg	11	8	<3	<3	<3	<3
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3
Hexavalent Chromium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Sulphate as SO4	mg/kg	53	33	22	76	13	23
Dissolved Organic Carbon	mg/l	<2	<2	3	<2	<2	<2
pH	pH units	9.93	9.35	9.64	9.23	8.23	9.45

Sample ID		B.2.10.4WK - Leachate A1 (i)	B.2.10.4WK - Leachate A1 (ii)	B.2.10.4WK - Leachate A2 (i)	B.2.10.4WK - Leachate A2 (ii)	B.2.10.4WK - Leachate A3 (i)	B.2.10.4WK - Leachate A3 (ii)
Site		**B**	**B**	**B**	**B**	**B**	**B**
Sample		**B2**	**B2**	**B2**	**B2**	**B2**	**B2**
Subsample		**A1**	**A1**	**A2**	**A2**	**A3**	**A3**
Preparation		**Fine Powder - D&C**	**Fine Powder - D&C**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**
Aggregate Material		**Aggregate**	**Aggregate**	**Aggregate**	**Aggregate**	**Aggregate**	**Aggregate**
Aggregate Size		**10mm**	**10mm**	**10mm**	**10mm**	**10mm**	**10mm**
Time in Stockpile		**4 Weeks**	**4 Weeks**	**4 Weeks**	**4 Weeks**	**4 Weeks**	**4 Weeks**
Carbonisation Time		**0 weeks**	**0 weeks**	**3 weeks**	**3 weeks**	**6 weeks**	**6 weeks**
Determinand	**Unit**						
Aluminium	mg/kg	3.4	2.1	2.2	1.8	2.7	2.1
Antimony	mg/kg	<0.02	0.03	0.03	<0.02	0.03	0.02
Arsenic	mg/kg	<0.025	<0.025	0.03	<0.025	<0.025	<0.025
Barium	mg/kg	<0.03	<0.03	<0.03	0.04	<0.03	<0.03
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/kg	83	85	93	86	75	91
Chromium	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	mg/kg	<0.02	<0.02	0.04	0.03	<0.02	0.09
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potassium	mg/kg	4	7	9	12	5	7
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Vanadium	mg/kg	0.03	0.019	0.044	0.028	0.022	<0.015
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Natural Moisture Content	%	-	-	4.3	4.3	4.8	4.8
Moisture Content 105C (% Dry Weight)	%	0.8	0.8	95.8	95.8	95.4	95.4
Dry Matter Content Ratio 105°C	%	99.2	99.2				
Mass of raw test portion	kg	0.0907	0.0906				
Leachant Volume	l	0.899	0.899				
Chloride	mg/kg	<3	<3	<3	<3	<3	<3
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3
Hexavalent Chromium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Sulphate as SO4	mg/kg	42	45	72	36	21	18
Dissolved Organic Carbon	mg/l	<2	<2	3	<2	<2	<2
pH	pH units	9.3	9.27	9.33	9.31	9.27	8.36

Table III-3 - 10:1 L/S Leachate Analysis, Inorganics and Metals

Sample ID		A.1.6FP.3W - Leachate B1 (i)	A.1.6FP.3W - Leachate B1 (ii)	A.1.6FP.3W - Leachate B2 (i)	A.1.6FP.3W - Leachate B2 (ii)	A.1.6FP.3W - Leachate B3 (i)	A.1.6FP.3W - Leachate B3 (ii)	A.1.6FP.3W - Leachate C1	A.1.6FP.3W - Leachate C1 (ii)
Site		A	A	A	A	A	A	A	A
Sample		A1	A1	A1	A1	A1	A1	A1	A1
Subsample		B1	B1	B2	B2	B3	B3	C1	C2
Preparation		BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C	Fine Powder - D&C
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	Concrete
Aggregate Size		6FP	6FP	6FP	6FP	6FP	6FP	6FP	6FP
Time in Stockpile		3 weeks	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks	0 weeks	0 weeks
Determinand	Unit								
Aluminium	mg/kg	11	11.1	0.8	1	1.1	0.4	8.6	8.7
Antimony	mg/kg	<0.02	0.02	0.04	0.05	<0.02	0.04	0.03	0.02
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Barium	mg/kg	0.25	0.21	0.11	0.1	0.05	0.07	0.29	0.3
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/kg	756	619	517	539	204	320	1090	1160
Chromium	mg/kg	0.435	0.259	0.461	0.472	0.066	0.115	0.822	0.822
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	mg/kg	0.04	0.02	0.05	0.05	<0.02	<0.02	0.14	0.14
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potassium	mg/kg	258	301	144	152	62	72	267	272
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Vanadium	mg/kg	0.073	0.087	0.218	0.228	0.133	0.156	0.063	0.055
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03
Natural Moisture Content	%	-	-	12.4	12.4	19.5	19.5	-	-
Moisture Content 105C (% Dry Weight)	%	10.4	10.4	89	89	83.7	83.7	<0.1	<0.1
Dry Matter Content Ratio 105°C	%	90.6	90.6					100	100
Mass of raw test portion	kg	0.0989	0.0988					0.0904	0.0904
Leachant Volume	l	0.891	0.891					0.9	0.9
Chloride	mg/kg	12	6	11	11	6	<3	36	36
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3	<3	<3
Hexavalent Chromium	mg/kg	0.39	0.11	<0.06	<0.06	<0.06	<0.06	<0.06	0.79
Sulphate as SO4	mg/kg	601	530	847	844	302	510	844	849
Dissolved Organic Carbon	mg/l	<2	3	4	2	<2	<2	5	3
pH	pH units	9.85	11.4	10.4	10.5	9.84	10.2	11.7	11.7

Sample ID		B.1.10.1WK - Leachate B1 (i)	B.1.10.1WK - Leachate B1 (ii)	B.1.10.1WK - Leachate B2 (i)	B.1.10.1WK - Leachate B2 (ii)	B.1.10.1WK - Leachate B3 (i)	B.1.10.1WK - Leachate B3 (ii)	B.1.10.1WK - Leachate C1	B.1.10.1WK - Leachate C1 (ii)
Site		B	B	B	B	B	B	B	B
Sample		B1	B1	B1	B1	B1	B1	B1	B1
Subsample		B1	B1	B2	B2	B3	B3	C1	C2
Preparation		Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C	As Received	As Received
Aggregate Material		Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate
Aggregate Size		10mm	10mm	10mm	10mm	10mm	10mm	10mm	10mm
Time in Stockpile		1 Week	1 Week	1 Week	1 Week	1 Week	1 Week	1 Week	1 Week
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks	0 weeks	0 weeks
Determinand	Unit								
Aluminium	mg/kg	3.2	4.1	1.1	0.9	1.5	1.6	1.6	1.8
Antimony	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic	mg/kg	<0.025	0.027	<0.025	<0.025	0.033	<0.025	<0.025	0.045
Barium	mg/kg	0.04	0.05	0.04	0.04	0.03	<0.03	0.04	0.03
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/kg	158	201	106	105	89	83	112	103
Chromium	mg/kg	0.024	0.03	<0.015	<0.015	<0.015	<0.015	0.019	0.017
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	mg/kg	0.06	0.07	0.05	0.05	0.03	0.03	0.09	0.1
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potassium	mg/kg	13	15	12	12	6	8	20	18
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Vanadium	mg/kg	0.115	0.116	0.057	0.052	0.042	0.045	0.075	0.062
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Natural Moisture Content	%	-	-	11.1	11.1	10.5	10.5	-	-
Moisture Content 105C (% Dry Weight)	%	1	1	90	90	90.5	90.5	<0.1	<0.1
Dry Matter Content Ratio 105°C	%	99	99					100	100
Mass of raw test portion	kg	0.0906	0.0912					0.0897	0.0895
Leachant Volume	l	0.899	0.899					0.9	0.9
Chloride	mg/kg	20	19	4	<3	<3	<3	35	33
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3	5	3
Hexavalent Chromium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Sulphate as SO4	mg/kg	127	147	91	217	35	28	121	116
Dissolved Organic Carbon	mg/l	<2	<2	3	<2	<2	<2	2	<2
pH	pH units	10	10.3	9.39	9.24	8.94	9.44	9.58	9.57

Sample ID		B.2.10.4WK - Leachate B1 (i)	B.2.10.4WK - Leachate B1 (ii)	B.2.10.4WK - Leachate B2 (i)	B.2.10.4WK - Leachate B2 (ii)	B.2.10.4WK - Leachate B3 (i)	B.2.10.4WK - Leachate B3 (ii)	B.2.10.4WK - Leachate C1	B.2.10.4WK - Leachate C1 (ii)
Site		B	B	B	B	B	B	B	B
Sample		B2	B2	B2	B2	B2	B2	B2	B2
Subsample		B1	B1	B2	B2	B3	B3	C1	C2
Preparation		Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C	As Received	As Received
Aggregate Material		Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate
Aggregate Size		10mm	10mm	10mm	10mm	10mm	10mm	10mm	10mm
Time in Stockpile		4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks	0 weeks	0 weeks
Determinand	Unit								
Aluminium	mg/kg	2.1	2.6	0.8	1	1.7	1.9	0.6	0.7
Antimony	mg/kg	0.04	0.03	<0.02	<0.02	0.03	<0.02	<0.02	0.03
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Barium	mg/kg	0.05	0.06	0.11	0.07	<0.03	<0.03	0.08	0.08
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	mg/kg	182	193	309	152	91	80	229	226
Chromium	mg/kg	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	0.017	0.019
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum	mg/kg	0.04	0.03	0.07	0.07	0.03	<0.02	0.1	0.1
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Potassium	mg/kg	12	13	14	13	7	7	17	19
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Vanadium	mg/kg	0.058	0.065	0.017	0.026	0.034	0.025	0.064	0.054
Zinc	mg/kg	<0.03	0.07	0.04	<0.03	<0.03	<0.03	<0.03	<0.03
Natural Moisture Content	%	-	-	7.4	7.4	10.7	10.7	-	-
Moisture Content 105C (% Dry Weight)	%	0.3	0.3	93.1	93.1	90.3	90.3	<0.1	<0.1
Dry Matter Content Ratio 105°C	%	99.7	99.7					100	100
Mass of raw test portion	kg	0.0908	0.0903					0.0903	0.0899
Leachant Volume	l	0.9	0.9					0.9	0.9
Chloride	mg/kg	8	4	<3	<3	<3	<3	24	23
Fluoride	mg/kg	<3	<3	4	4	<3	<3	4	4
Hexavalent Chromium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Sulphate as SO4	mg/kg	302	262	641	223	25	18	422	436
Dissolved Organic Carbon	mg/l	2	3	3	<2	<2	<2	3	<2
pH	pH units	9.54	11.5	8.98	9.1	8.66	9.41	9.32	9.35

Table III-3 - 10:1 L/S Leachate Analysis, Inorganics and Metals

Sample ID		C.1.30.3DAY - Leachate A1 (i)	C.1.30.3DAY - Leachate A1 (ii)	C.1.30.3DAY - Leachate A2 (i)	C.1.30.3DAY - Leachate A2 (ii)	C.1.30.3DAY - Leachate A3 (i)	C.1.30.3DAY - Leachate A3 (ii)	
Site		C	C	C	C	C	C	
Sample		C1	C1	C1	C1	C1	C1	
Subsample		A1	A1	A2	A2	A3	A3	
Preparation		Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	
Aggregate Size		30mm	30mm	30mm	30mm	30mm	30mm	
Time in Stockpile		<3 Days	<3 Days	<3 Days	<3 Days	<3 Days	<3 Days	
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks	
Determinand	Unit							
Aluminium	mg/kg	5	4.3	7.1	13.3	8	3.2	
Antimony	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	0.032	<0.025	
Barium	mg/kg	1.04	1.04	0.31	0.18	0.09	0.55	
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Calcium	mg/kg	2190	2210	565	981	473	7680, 379 (rerun)	
Chromium	mg/kg	0.306	0.285	0.134	0.124	0.071	0.088	
Copper	mg/kg	0.17	0.11	<0.07	<0.07	<0.07	<0.07	
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Molybdenum	mg/kg	0.06	0.06	<0.02	<0.02	<0.02	<0.02	
Nickel	mg/kg	0.02	0.03	<0.02	<0.02	<0.02	<0.02	
Potassium	mg/kg	260	259	133	108	66	97	
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Vanadium	mg/kg	<0.015	0.016	0.144	0.092	0.167	0.12	
Zinc	mg/kg	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	
Natural Moisture Content	%	-	-	10.6	10.6	11.1	11.1	
Moisture Content 105C (% Dry Weight)	%	4.6	4.6	90.4	90.4	90	90	
Dry Matter Content Ratio 105°C	%	95.6	95.6					
Mass of raw test portion	kg	0.0945	0.0944					
Leachant Volume	l	0.896	0.896					
Chloride	mg/kg	46	49	11	18	5	11	
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3	
Hexavalent Chromium	mg/kg	0.2	0.22	<0.06	<0.06	<0.06	<0.06	
Sulphate as SO4	mg/kg	237	354	4430, 425 (rerun)	384	336	14300, 925 (rerun)	
Dissolved Organic Carbon	mg/l	6	9	3	2	2	<2	
pH	pH units	12.1	12.1	11.4	11.7	11.1	11.1	

Sample ID		C.2.30.1WK - Leachate A1 (i)	C.2.30.1WK - Leachate A1 (ii)	C.2.30.1WK - Leachate A2 (i)	C.2.30.1WK - Leachate A2 (ii)	C.2.30.1WK - Leachate A3 (i)	C.2.30.1WK - Leachate A3 (ii)	
Site		C	C	C	C	C	C	
Sample		C2	C2	C2	C2	C2	C2	
Subsample		A1	A1	A2	A2	A3	A3	
Preparation		Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	
Aggregate Size		30mm	30mm	30mm	30mm	30mm	30mm	
Time in Stockpile		1 Week	1 Week	1 Week	1 Week	1 Week	1 Week	
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks	
Determinand	Unit							
Aluminium	mg/kg	5.7	2.6	1.3	2.2	1.6	3.6	
Antimony	mg/kg	0.03	<0.02	0.04	0.04	<0.02	<0.02	
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	<0.025	0.095, 0.032 (rerun)	
Barium	mg/kg	0.27	0.42	0.32	0.11	0.06	0.05	
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Calcium	mg/kg	1490	2670	2550	1140	536	469	
Chromium	mg/kg	0.399	0.465	0.167	0.233	0.14	0.139	
Copper	mg/kg	0.08	0.1	<0.07	<0.07	<0.07	<0.07	
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Molybdenum	mg/kg	0.06	0.06	0.03	0.03	<0.02	<0.02	
Nickel	mg/kg	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	
Potassium	mg/kg	121	132	93	89	49	46	
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Vanadium	mg/kg	0.134	0.112	0.175	0.222	0.257	0.239	
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Natural Moisture Content	%	-	-	12.8	12.8	14.7	14.7	
Moisture Content 105C (% Dry Weight)	%	5	5	88.6	88.6	87.2	87.2	
Dry Matter Content Ratio 105°C	%	95.2	95.2					
Mass of raw test portion	kg	0.0948	0.0941					
Leachant Volume	l	0.896	0.896					
Chloride	mg/kg	39	44	14	12	3	6	
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3	
Hexavalent Chromium	mg/kg	0.24	0.26	<0.06	<0.06	<0.06	<0.06	
Sulphate as SO4	mg/kg	2150	4270	5540	2140	867	533	
Dissolved Organic Carbon	mg/l	4	3	4	<2	3	<2	
pH	pH units	11.4	11.4	10.4	10.6	10.2	10.7	

Sample ID		C.3.30.6MONTH - Leachate A1 (i)	C.3.30.6MONTH - Leachate A1 (ii)	C.3.30.6MONTH - Leachate A2 (i)	C.3.30.6MONTH - Leachate A2 (ii)	C.3.30.6MONTH - Leachate A3 (i)	C.3.30.6MONTH - Leachate A3 (ii)	
Site		C	C	C	C	C	C	
Sample		C3	C3	C3	C3	C3	C3	
Subsample		A1	A1	A2	A2	A3	A3	
Preparation		Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	
Aggregate Size		30mm	30mm	30mm	30mm	30mm	30mm	
Time in Stockpile		6 Months	6 Months	6 Months	6 Months	6 Months	6 Months	
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks	
Determinand	Unit							
Aluminium	mg/kg	8.2	9.2	19.7	20.5	15.8	20.1	
Antimony	mg/kg	<0.02	<0.02	<0.02	0.04	0.04	<0.02	
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	
Barium	mg/kg	1.38	1.12	0.13	0.08	0.11	0.1	
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Calcium	mg/kg	3630	3220	839	527	750	631	
Chromium	mg/kg	0.104	0.111	0.189	0.096	0.089	0.112	
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Molybdenum	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Potassium	mg/kg	76	63	92	74	48	58	
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Vanadium	mg/kg	<0.015	<0.015	0.055	0.055	0.059	0.107	
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Natural Moisture Content	%	-	-	14.1	14.1	9.5	9.5	
Moisture Content 105C (% Dry Weight)	%	9.1	9.1	87.6	87.6	91.3	91.3	
Dry Matter Content Ratio 105°C	%	91.6	91.6					
Mass of raw test portion	kg	0.0983	0.0984					
Leachant Volume	l	0.892	0.892					
Chloride	mg/kg	20	18	12	6	5	4	
Fluoride	mg/kg	<3	<3	5	3	4	4	
Hexavalent Chromium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	
Sulphate as SO4	mg/kg	21	27	279	109	215	219	
Dissolved Organic Carbon	mg/l							
pH	pH units	12.3	12.3	11.7	11.4	11.6	11.4	

Table III-3 - 10:1 L/S Leachate Analysis, Inorganics and Metals

Sample ID		C.1.30.3DAY - Leachate B1 (i)	C.1.30.3DAY - Leachate B1 (ii)	C.1.30.3DAY - Leachate B2 (i)	C.1.30.3DAY - Leachate B2 (ii)	C.1.30.3DAY - Leachate B3 (i)	C.1.30.3DAY - Leachate B3 (ii)		C.1.30.3DAY - Leachate C1	C.1.30.3DAY - Leachate C1 (ii)
Site		C	C	C	C	C	C		C	C
Sample		C1	C1	C1	C1	C1	C1		C1	C1
Subsample		B1	B1	B2	B2	B3	B3		C1	C2
Preparation		Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C		As Received	As Received
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete		Concrete	Concrete
Aggregate Size		30mm	30mm	30mm	30mm	30mm	30mm		30mm	30mm
Time in Stockpile		<3 Days	<3 Days	<3 Days	<3 Days	<3 Days	<3 Days		<3 Days	<3 Days
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks		0 weeks	0 weeks
Determinand	Unit									
Aluminium	mg/kg	4.8	3.6	8.8	8.4	4.3	5.4		5.8	6.8
Antimony	mg/kg	<0.02	<0.02	0.04	0.04	0.03	0.02		0.03	<0.02
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025		<0.025	<0.025
Barium	mg/kg	1.11	1.13	0.12	0.11	0.06	0.06		3.66	3.58
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Calcium	mg/kg	2430	2720	683	650	414	409		4200	4200
Chromium	mg/kg	0.261	0.288	0.202	0.252	0.125	0.105		0.185	0.194
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07		<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01
Molybdenum	mg/kg	0.05	0.06	0.03	0.03	<0.02	<0.02		0.06	0.06
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02
Potassium	mg/kg	184	199	129	155	91	88		235	255
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03
Vanadium	mg/kg	<0.015	<0.015	0.2	0.209	0.202	0.195		<0.015	<0.015
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03
Natural Moisture Content	%	-	-	15.5	15.5	15.6	15.6		-	-
Moisture Content 105C (% Dry Weight)	%	1.9	1.9	86.5	86.5	86.5	86.5		<0.1	<0.1
Dry Matter Content Ratio 105°C	%	98.2	98.2						100	100
Mass of raw test portion	kg	0.0913	0.092						0.0904	0.0901
Leachant Volume	l	0.898	0.898						0.9	0.9
Chloride	mg/kg	52	61	29	32	11	12		66	68
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3		<3	<3
Hexavalent Chromium	mg/kg	0.21	0.27	<0.06	<0.06	<0.06	<0.06		<0.06	<0.06
Sulphate as SO4	mg/kg	228	246	624	703	330	278		17	18
Dissolved Organic Carbon	mg/l	5	5	4	3	2	<2		6	5
pH	pH units	12.1	12.2	11.3	11.2	11	11		12.4	12.4

Sample ID		C.2.30.1WK - Leachate B1 (i)	C.2.30.1WK - Leachate B1 (ii)	C.2.30.1WK - Leachate B2 (i)	C.2.30.1WK - Leachate B2 (ii)	C.2.30.1WK - Leachate B3 (i)	C.2.30.1WK - Leachate B3 (ii)		C.2.30.1WK - Leachate C1	C.2.30.1WK - Leachate C1 (ii)
Site		C	C	C	C	C	C		C	C
Sample		C2	C2	C2	C2	C2	C2		C2	C2
Subsample		B1	B1	B2	B2	B3	B3		C1	C2
Preparation		Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C		As Received	As Received
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete		Concrete	Concrete
Aggregate Size		30mm	30mm	30mm	30mm	30mm	30mm		30mm	30mm
Time in Stockpile		1 Week	1 Week	1 Week	1 Week	1 Week	1 Week		1 Week	1 Week
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks		0 weeks	0 weeks
Determinand	Unit									
Aluminium	mg/kg	6	4.7	3.4	3.5	1.3	1.6		3.8	3.7
Antimony	mg/kg	<0.02	0.03	0.06	0.03	0.02	0.02		<0.02	0.03
Arsenic	mg/kg	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025		<0.025	<0.025
Barium	mg/kg	0.39	0.42	0.09	0.1	0.04	0.05		0.4	0.4
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Calcium	mg/kg	1500	1640	722	807	382	422		1750	1770
Chromium	mg/kg	0.465	0.476	0.388	0.392	0.129	0.139		0.803	0.779
Copper	mg/kg	0.08	0.08	<0.07	<0.07	<0.07	<0.07		<0.07	0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01
Molybdenum	mg/kg	0.06	0.07	0.04	0.05	<0.02	<0.02		0.15	0.14
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02
Potassium	mg/kg	133	139	97	100	49	53		181	178
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03
Vanadium	mg/kg	0.051	0.04	0.264	0.26	0.295	0.284		0.038	0.036
Zinc	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03
Natural Moisture Content	%	-	-	17.1	17.1	17.9	17.9		-	-
Moisture Content 105C (% Dry Weight)	%	4.3	4.3	85.4	85.4	84.8	84.8		<0.1	<0.1
Dry Matter Content Ratio 105°C	%	95.9	95.9						100	100
Mass of raw test portion	kg	0.0943	0.0936						0.0902	0.0904
Leachant Volume	l	0.896	0.896						0.9	0.9
Chloride	mg/kg	39	49	30	28	<3	3		71	66
Fluoride	mg/kg	<3	<3	<3	<3	5	3		<3	<3
Hexavalent Chromium	mg/kg	0.42	0.34	<0.06	<0.06	<0.06	<0.06		0.49	0.64
Sulphate as SO4	mg/kg	559	769	1110	1280	511	601		648	712
Dissolved Organic Carbon	mg/l	3	4	4	2	2	<2		10	10
pH	pH units	11.8	11.9	10.7	10.7	10.2	10.4		11.9	12

Sample ID		C.3.30.6MONTH - Leachate B1 (i)	C.3.30.6MONTH - Leachate B1 (ii)	C.3.30.6MONTH - Leachate B2 (i)	C.3.30.6MONTH - Leachate B2 (ii)	C.3.30.6MONTH - Leachate B3 (i)	C.3.30.6MONTH - Leachate B3 (ii)		C.3.30.6MONTH - Leachate C1	C.3.30.6MONTH - Leachate C1 (ii)
Site		C	C	C	C	C	C		C	C
Sample		C3	C3	C3	C3	C3	C3		C3	C3
Subsample		B1	B1	B2	B2	B3	B3		C1	C2
Preparation		Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C		As Received	As Received
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete		Concrete	Concrete
Aggregate Size		30mm	30mm	30mm	30mm	30mm	30mm		30mm	30mm
Time in Stockpile		6 Months	6 Months	6 Months	6 Months	6 Months	6 Months		6 Months	6 Months
Carbonisation Time		0 weeks	0 weeks	3 weeks	3 weeks	6 weeks	6 weeks		0 weeks	0 weeks
Determinand	Unit									
Aluminium	mg/kg	4.8	4.9	21.3	21.4	15.8	15.4		2	2
Antimony	mg/kg	<0.02	<0.02	<0.02	0.03	0.03	<0.02		<0.02	0.02
Arsenic	mg/kg	<0.025	0.028	<0.025	<0.025	<0.025	<0.025		<0.025	<0.025
Barium	mg/kg	1.74	1.74	0.13	0.13	0.09	0.08		2.76	2.8
Cadmium	mg/kg	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005
Calcium	mg/kg	4970	4910	713	744	605	625		7430	7970
Chromium	mg/kg	0.093	0.096	0.16	0.168	0.106	0.102		0.114	0.108
Copper	mg/kg	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07		<0.07	<0.07
Lead	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	<0.05
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01
Molybdenum	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		0.02	<0.02
Nickel	mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	<0.02
Potassium	mg/kg	88	85	85	90	84	91		222	225
Selenium	mg/kg	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03
Vanadium	mg/kg	<0.015	<0.015	0.046	0.043	0.085	0.089		<0.015	<0.015
Zinc	mg/kg	<0.03	0.03	<0.03	<0.03	<0.03	<0.03		<0.03	<0.03
Natural Moisture Content	%	-	-	12.9	12.9	22.3	12.9		-	-
Moisture Content 105C (% Dry Weight)	%	6.9	6.9	88.6	88.6	81.8	88.6		<0.1	<0.1
Dry Matter Content Ratio 105°C	%	93.6	93.6						100	100
Mass of raw test portion	kg	0.096	0.096						0.0899	0.0899
Leachant Volume	l	0.894	0.894						0.9	0.9
Chloride	mg/kg	29	28	14	16	12	11		43	46
Fluoride	mg/kg	<3	<3	<3	<3	<3	<3		<3	<3
Hexavalent Chromium	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06		<0.6	<0.3
Sulphate as SO4	mg/kg	16	7	132	123	194	169		<5	10
Dissolved Organic Carbon	mg/l	2	2	3	2	2	<2		4	4
pH	pH units	12.4	12.4	11.6	11.6	11.4	11.5		12.6	12.6

Table III-5 - Total vs Leachate Concentrations for Selected Determinands

Sample ID		A.1.6FP.3W	B.1.10.1WK	B.2.10.4WK	C.1.30.3DAY	C.2.30.1WK	C.3.30.6MONTH
Site		**A**	**B**	**B**	**C**	**C**	**C**
Sample		**A1**	**B1**	**B2**	**C1**	**C2**	**C3**
Aggregate Material		**Concrete**	**Natural**	**Natural**	**Concrete**	**Concrete**	**Concrete**
Aggregate Size		**6FP**	**<10mm**	**<10mm**	**<30mm**	**<30mm**	**<30mm**
Time in Stockpile		**3 weeks**	**1 week**	**4 weeks**	**<3 days**	**1 week**	**6 months**
Test Type	**Unit**						
Total >C10-C44 TPH (Mineral Oil)							
Total Concentration	mg/kg	519	<50.4	<50.4	470	107	<50.4
Leachate 10:1 L/S in All Subsamples	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total PAHs Including Coronene							
Total Concentration	mg/kg	<0.64	<0.64	<0.64	<0.64	7.05	<0.64
Leachate 10:1 L/S A1 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	0.00759	0.15967	<0.00273
Leachate 10:1 L/S A2 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	0.01579	<0.00273
Leachate 10:1 L/S A3 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	0.11934	0.00302	<0.00273
Leachate 10:1 L/S B1 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	0.01268	<0.00273
Leachate 10:1 L/S B2 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	0.00392	<0.00273
Leachate 10:1 L/S B3 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	<0.00273	<0.00273
Leachate 10:1 L/S C1 Subsample	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	0.00741	<0.00273
Chromium, Total							
Total Concentration	mg/kg	24.1	29.2	28.8	27.3	35.5	48.4
Leachate 10:1 L/S A1 Subsample	mg/kg	0.131 , 0.151	<0.015	<0.015	0.285, 0.306	0.399, 0.465	0.104, 0.111
Leachate 10:1 L/S A2 Subsample	mg/kg	0.138, 0.179	<0.015	<0.015	0.134, 0.124	0.167,0.233	0.189, 0.096
Leachate 10:1 L/S A3 Subsample	mg/kg	0.075, 0.05	<0.015	<0.015	0.071, 0.088	0.14, 0.139	0.089, 0.112
Leachate 10:1 L/S B1 Subsample	mg/kg	0.435, 0.259	0.024, 0.03	<0.015	0.261, 0.288	0.465, 0.476	0.093, 0.096
Leachate 10:1 L/S B2 Subsample	mg/kg	0.461 , 0.472	<0.015	<0.015	0.202, 0.252	0.388, 0.392	0.16, 0.168
Leachate 10:1 L/S B3 Subsample	mg/kg	0.066, 0.115	<0.015	<0.015	0.125, 0.105	0.129, 0.139	0.106, 0.102
Leachate 10:1 L/S C1 Subsample	mg/kg	0.822, 0.822	0.017, 0.019	0.019, 0.017	0.185, 0.195	0.803, 0.779	0.114, 0.108
Chromium, VI							
Total Concentration	mg/kg	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Leachate 10:1 L/S A1 Subsample	mg/kg	<0.06, 0.07	<0.06	<0.06	0.2, 0.22	0.24, 0.26	<0.06
Leachate 10:1 L/S A2 Subsample	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Leachate 10:1 L/S A3 Subsample	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Leachate 10:1 L/S B1 Subsample	mg/kg	0.39, 0.11	<0.06	<0.06	0.21, 0.27	0.42, 0.34	<0.06
Leachate 10:1 L/S B2 Subsample	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Leachate 10:1 L/S B3 Subsample	mg/kg	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Leachate 10:1 L/S C1 Subsample	mg/kg	<0.06, 0.79	<0.06	<0.06	<0.06	0.49, 0.64	<0.06
pH							
Total Concentration	pH units	11.5	9.23	9.3	12.3	11.7	12.5
Leachate 10:1 L/S A1 Subsample	pH units	11.3, 11.2	9.93, 9.35	9.3, 9.27	12.1, 12.1	11.4,11.4	12.3, 12.3
Leachate 10:1 L/S A2 Subsample	pH units	10.3, 10.1	9.64, 9.23	9.33, 9.31	11.4, 11.7	10.4, 10.6	11.7, 11.4
Leachate 10:1 L/S A3 Subsample	pH units	9.88, 10	8.23, 9.45	9.27, 8.36	11.1, 11.1	10.2, 10.7	11.6, 11.4
Leachate 10:1 L/S B1 Subsample	pH units	9.85, 11.4	10, 10.3	9.54, 11.5	12.1, 12.2	11.8, 11.9	12.4, 12.4
Leachate 10:1 L/S B2 Subsample	pH units	10.4, 10.5	9.39, 9.24	8.98, 9.1	11.3, 11.2	10.7, 10.7	11.6, 11.6
Leachate 10:1 L/S B3 Subsample	pH units	9.84, 10.2	8.94, 9.44	8.66, 9.41	11, 11	10.2, 10.4	11.4, 11.5
Leachate 10:1 L/S C1 Subsample	pH units	11.7, 11.7	9.58, 9.57	9.32, 9.35	12.4, 12.4	11.9, 12	12.6, 12.6

Note: When a Subsample has been analysed in duplicate two results are given. When both results were <MDL, just the MDL is shown

Table III-4 - 10:1 L/S Leachate Analysis, Polycyclic Aromatic Hydrocarbons

Sample ID		A.1.6FP.3W - Leachate A1 (i)	A.1.6FP.3W - Leachate A2 (i)	A.1.6FP.3W - Leachate A3 (i)	A.1.6FP.3W - Leachate B1 (i)	A.1.6FP.3W - Leachate B2 (i)	A.1.6FP.3W - Leachate B3 (i)	A.1.6FP.3W - Leachate C1
Site		A	A	A	A	A	A	A
Sample		A1	A1	A1	A1	A1	A1	A1
Subsample		A1	A2	A3	B1	B2	B3	C1
Preparation		As Received	BS12457 95%<4mm	Fine Powder - D&C	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C
Aggregate Material		Concrete	Concrete	Concrete	Concrete	Concrete	Concrete	Concrete
Aggregate Size		6FP	6FP	6FP	6FP	6FP	6FP	6FP
Time in Stockpile		3 weeks	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks
Carbonisation Time		0 weeks	3 weeks	6 weeks	0 weeks	3 weeks	6 weeks	0 weeks
Determinand	Unit							
Naphthalene	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005
Acenaphthene	mg/kg	0.00026	0.00024	0.00035	<0.00005	0.00005	0.0001	0.00033
Fluorene	mg/kg	0.00037	0.00012	0.00019	<0.00005	<0.00005	0.00011	0.00013
Phenanthrene	mg/kg	0.00111	0.00047	0.00036	0.00015	0.00006	0.00045	0.00019
Anthracene	mg/kg	0.00008	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Fluoranthene	mg/kg	0.00039	0.00019	0.0002	0.00012	<0.00005	0.00015	0.00012
Pyrene	mg/kg	0.00029	0.00014	0.00018	0.00011	<0.00005	0.00013	0.00011
Benzo(a)anthracene	mg/kg	<0.00005	<0.00005	0.00008	<0.00005	<0.00005	<0.00005	<0.00005
Chrysene	mg/kg	0.00012	<0.00005	0.0001	0.00006	<0.00005	0.00006	0.00006
Benzo(bk)fluoranthene	mg/kg	<0.00008	<0.00008	0.00015	<0.00008	<0.00008	<0.00008	<0.00008
Benzo(a)pyrene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Indeno(123cd)pyrene	mg/kg	<0.00005	<0.00005	0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Dibenzo(ah)anthracene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Benzo(ghi)perylene	mg/kg	<0.00005	<0.00005	0.00006	<0.00005	<0.00005	<0.00005	<0.00005
Coronene	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PAH 17 Total	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	<0.00273	<0.00273	<0.00273
Benzo(b)fluoranthene	mg/kg	<0.00008	<0.00008	0.00011	<0.00008	<0.00008	<0.00008	<0.00008
Benzo(k)fluoranthene	mg/kg	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008

Sample ID		B.1.10.1WK - Leachate A1 (i)	B.1.10.1WK - Leachate A2 (i)	B.1.10.1WK - Leachate A3 (i)	B.1.10.1WK - Leachate B1 (i)	B.1.10.1WK - Leachate B2 (i)	B.1.10.1WK - Leachate B3 (i)	B.1.10.1WK - Leachate C1
Site		B	B	B	B	B	B	B
Sample		B1	B1	B1	B1	B1	B1	B1
Subsample		A1	A2	A3	B1	B2	B3	C1
Preparation		Fine Powder - D&C	As Received	BS12457 95%<4mm	Fine Powder - D&C	As Received	BS12457 95%<4mm	As Received
Aggregate Material		Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate
Aggregate Size		10mm	10mm	10mm	10mm	10mm	10mm	10mm
Time in Stockpile		1 Week	1 Week	1 Week	1 Week	1 Week	1 Week	1 Week
Carbonisation Time		0 weeks	3 weeks	6 weeks	0 weeks	3 weeks	6 weeks	0 weeks
Determinand	Unit							
Naphthalene	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Acenaphthylene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00006
Acenaphthene	mg/kg	0.00006	<0.00005	<0.00005	0.00009	0.00006	<0.00005	0.00018
Fluorene	mg/kg	<0.00005	<0.00005	<0.00005	0.00009	<0.00005	<0.00005	0.00006
Phenanthrene	mg/kg	0.00015	<0.00005	<0.00005	0.00066	<0.00005	<0.00005	0.00021
Anthracene	mg/kg	<0.00005	<0.00005	<0.00005	0.00013	<0.00005	<0.00005	<0.00005
Fluoranthene	mg/kg	0.00014	<0.00005	<0.00005	0.00072	0.00008	0.00007	0.0001
Pyrene	mg/kg	0.00013	<0.00005	0.00007	0.00062	0.00006	0.00007	0.0001
Benzo(a)anthracene	mg/kg	<0.00005	<0.00005	<0.00005	0.00026	<0.00005	0.00005	<0.00005
Chrysene	mg/kg	0.00006	<0.00005	<0.00005	0.00032	<0.00005	0.00005	<0.00005
Benzo(bk)fluoranthene	mg/kg	<0.00008	<0.00008	<0.00008	0.00031	<0.00008	<0.00008	<0.00008
Benzo(a)pyrene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Indeno(123cd)pyrene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Dibenzo(ah)anthracene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Benzo(ghi)perylene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Coronene	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PAH 17 Total	mg/kg	<0.00273	<0.00273	<0.00273	0.0032	<0.00273	<0.00273	<0.00273
Benzo(b)fluoranthene	mg/kg	<0.00008	<0.00008	<0.00008	0.00022	<0.00008	<0.00008	<0.00008
Benzo(k)fluoranthene	mg/kg	<0.00008	<0.00008	<0.00008	0.00009	<0.00008	<0.00008	<0.00008

Sample ID		B.2.10.4WK - Leachate A1 (i)	B.2.10.4WK - Leachate A2 (i)	B.2.10.4WK - Leachate A3 (i)	B.2.10.4WK - Leachate B1 (i)	B.2.10.4WK - Leachate B2 (i)	B.2.10.4WK - Leachate B3 (i)	B.2.10.4WK - Leachate C1
Site		B	B	B	B	B	B	B
Sample		B2	B2	B2	B2	B2	B2	B2
Subsample		A1	A2	A3	B1	B2	B3	C1
Preparation		Fine Powder - D&C	As Received	BS12457 95%<4mm	Fine Powder - D&C	As Received	BS12457 95%<4mm	As Received
Aggregate Material		Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate
Aggregate Size		10mm	10mm	10mm	10mm	10mm	10mm	10mm
Time in Stockpile		4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks	4 Weeks
Carbonisation Time		0 weeks	3 weeks	6 weeks	0 weeks	3 weeks	6 weeks	0 weeks
Determinand	Unit							
Naphthalene	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Acenaphthylene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Acenaphthene	mg/kg	0.00007	<0.00005	0.00009	0.00012	0.00007	0.00016	0.00007
Fluorene	mg/kg	<0.00005	<0.00005	0.00009	0.00006	<0.00005	0.001	<0.00005
Phenanthrene	mg/kg	0.00022	<0.00005	0.00026	0.00053	0.0002	0.00052	0.00014
Anthracene	mg/kg	<0.00005	<0.00005	<0.00005	0.00009	<0.00005	0.0001	<0.00005
Fluoranthene	mg/kg	0.0002	<0.00005	0.00025	0.0006	0.00025	0.00075	0.00014
Pyrene	mg/kg	0.00019	<0.00005	0.00025	0.00055	0.00023	0.00073	0.00015
Benzo(a)anthracene	mg/kg	0.00007	<0.00005	0.00015	0.00023	0.00012	0.00034	<0.00005
Chrysene	mg/kg	0.00009	<0.00005	0.00015	0.00025	0.00012	0.00036	<0.00005
Benzo(bk)fluoranthene	mg/kg	<0.00008	<0.00008	0.00024	0.00028	0.00019	0.00058	<0.00008
Benzo(a)pyrene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	0.00009	0.0002	<0.00005
Indeno(123cd)pyrene	mg/kg	<0.00005	<0.00005	0.00006	<0.00005	0.00006	0.00015	<0.00005
Dibenzo(ah)anthracene	mg/kg	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Benzo(ghi)perylene	mg/kg	<0.00005	<0.00005	0.00007	<0.00005	<0.00005	0.00014	<0.00005
Coronene	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
PAH 17 Total	mg/kg	<0.00273	<0.00273	<0.00273	<0.00273	<0.00273	0.00503	<0.00273
Benzo(b)fluoranthene	mg/kg	<0.00008	<0.00008	0.00017	0.0002	0.00014	0.00042	<0.00008
Benzo(k)fluoranthene	mg/kg	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.00016	<0.00008

Table III-4 - 10:1 L/S Leachate Analysis, Polycyclic Aromatic Hydrocarbons

Sample ID		**C.1.30.3DAY - Leachate A1 (i)**	**C.1.30.3DAY - Leachate A2 (i)**	**C.1.30.3DAY - Leachate A3 (i)**		**C.1.30.3DAY - Leachate B1 (i)**	**C.1.30.3DAY - Leachate B2 (i)**	**C.1.30.3DAY - Leachate B3 (i)**		**C.1.30.3DAY - Leachate C1**
Site		**C**	**C**	**C**		**C**	**C**	**C**		**C**
Sample		**C1**	**C1**	**C1**		**C1**	**C1**	**C1**		**C1**
Subsample		**A1**	**A2**	**A3**		**B1**	**B2**	**B3**		**C1**
Preparation		**Fine Powder - D&C**	**As Received**	**BS12457 95%<4mm**		**Fine Powder - D&C**	**As Received**	**BS12457 95%<4mm**		**As Received**
Aggregate Material		**Concrete**	**Concrete**	**Concrete**		**Concrete**	**Concrete**	**Concrete**		**Concrete**
Aggregate Size		**30mm**	**30mm**	**30mm**		**30mm**	**30mm**	**30mm**		**30mm**
Time in Stockpile		**<3 Days**	**<3 Days**	**<3 Days**		**<3 Days**	**<3 Days**	**<3 Days**		**<3 Days**
Carbonisation Time		**0 weeks**	**3 weeks**	**6 weeks**		**0 weeks**	**3 weeks**	**6 weeks**		**0 weeks**
Determinand	**Unit**									
Naphthalene	mg/kg	0.002	<0.001	0.003		<0.001	<0.001	<0.001		<0.001
Acenaphthylene	mg/kg	0.00026	<0.00005	0.00045		0.00013	<0.00005	<0.00005		0.00018
Acenaphthene	mg/kg	0.00095	0.0001	0.00181		0.00039	0.00009	0.00015		0.00078
Fluorene	mg/kg	0.00054	<0.00005	0.00196		0.00018	<0.00005	0.00011		0.00027
Phenanthrene	mg/kg	0.00173	0.00013	0.0135		0.00063	0.00012	0.00038		0.00069
Anthracene	mg/kg	0.00023	<0.00005	0.00437		0.00008	<0.00005	0.00005		0.00009
Fluoranthene	mg/kg	0.00078	0.00008	0.0223		0.00037	0.00008	0.00033		0.00031
Pyrene	mg/kg	0.00064	0.00007	0.0178		0.00031	0.00007	0.00029		0.00025
Benzo(a)anthracene	mg/kg	0.00013	<0.00005	0.00919		0.00008	<0.00005	0.00013		<0.00005
Chrysene	mg/kg	0.00017	<0.00005	0.00908		0.00011	<0.00005	0.00015		0.00007
Benzo(bk)fluoranthene	mg/kg	0.00016	<0.00008	0.0171		<0.00008	<0.00008	0.00025		<0.00008
Benzo(a)pyrene	mg/kg	<0.00005	<0.00005	0.00806		<0.00005	<0.00005	0.0001		<0.00005
Indeno(123cd)pyrene	mg/kg	<0.00005	<0.00005	0.00586		<0.00005	<0.00005	<0.00005		<0.00005
Dibenzo(ah)anthracene	mg/kg	<0.00005	<0.00005	0.00077		<0.00005	<0.00005	<0.00005		<0.00005
Benzo(ghi)perylene	mg/kg	<0.00005	<0.00005	0.00409		<0.00005	<0.00005	0.00008		<0.00005
Coronene	mg/kg	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
PAH 17 Total	mg/kg	0.00759	<0.00273	0.11934		<0.00273	<0.00273	<0.00273		<0.00273
Benzo(b)fluoranthene	mg/kg	0.00012	<0.00008	0.0123		<0.00008	<0.00008	0.00018		<0.00008
Benzo(k)fluoranthene	mg/kg	<0.00008	<0.00008	0.00479		<0.00008	<0.00008	<0.00008		<0.00008

Sample ID		**C.2.30.1WK - Leachate A1 (i)**	**C.2.30.1WK - Leachate A2 (i)**	**C.2.30.1WK - Leachate A3 (i)**		**C.2.30.1WK - Leachate B1 (i)**	**C.2.30.1WK - Leachate B2 (i)**	**C.2.30.1WK - Leachate B3 (i)**		**C.2.30.1WK - Leachate C1**
Site		**C**	**C**	**C**		**C**	**C**	**C**		**C**
Sample		**C2**	**C2**	**C2**		**C2**	**C2**	**C2**		**C2**
Subsample		**A1**	**A2**	**A3**		**B1**	**B2**	**B3**		**C1**
Preparation		**Fine Powder - D&C**	**As Received**	**BS12457 95%<4mm**		**Fine Powder - D&C**	**As Received**	**BS12457 95%<4mm**		**As Received**
Aggregate Material		**Concrete**	**Concrete**	**Concrete**		**Concrete**	**Concrete**	**Concrete**		**Concrete**
Aggregate Size		**30mm**	**30mm**	**30mm**		**30mm**	**30mm**	**30mm**		**30mm**
Time in Stockpile		**1 Week**	**1 Week**	**1 Week**		**1 Week**	**1 Week**	**1 Week**		**1 Week**
Carbonisation Time		**0 weeks**	**3 weeks**	**6 weeks**		**0 weeks**	**3 weeks**	**6 weeks**		**0 weeks**
Determinand	**Unit**									
Naphthalene	mg/kg	0.026	0.011	<0.001		0.005	0.002	<0.001		0.003
Acenaphthylene	mg/kg	0.00056	<0.00005	<0.00005		0.00012	0.00005	0.00006		0.00017
Acenaphthene	mg/kg	0.00776	0.00168	0.00026		0.00129	0.00041	0.00015		0.00107
Fluorene	mg/kg	0.00481	0.00056	0.00008		0.0006	0.00016	<0.00005		0.00045
Phenanthrene	mg/kg	0.03142	0.00114	0.00047		0.00231	0.0005	0.00027		0.0014
Anthracene	mg/kg	0.00603	0.00013	0.00011		0.00033	0.00007	0.00008		0.00015
Fluoranthene	mg/kg	0.02241	0.00041	0.00051		0.00103	0.00025	0.00033		0.00054
Pyrene	mg/kg	0.01791	0.00033	0.00047		0.00081	0.00021	0.00029		0.00043
Benzo(a)anthracene	mg/kg	0.00872	0.00012	0.00022		0.00028	0.00008	0.00014		0.00007
Chrysene	mg/kg	0.00883	0.00011	0.00024		0.00031	0.00006	0.00015		0.00013
Benzo(bk)fluoranthene	mg/kg	0.01251	0.00017	0.00044		0.0004	0.00013	0.00024		<0.00008
Benzo(a)pyrene	mg/kg	0.00645	0.00008	<0.00005		0.0002	<0.00005	<0.00005		<0.00005
Indeno(123cd)pyrene	mg/kg	0.00336	0.00006	0.00012		<0.00005	<0.00005	0.00006		<0.00005
Dibenzo(ah)anthracene	mg/kg	0.00044	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005
Benzo(ghi)perylene	mg/kg	0.00246	<0.00005	0.0001		<0.00005	<0.00005	0.00006		<0.00005
Coronene	mg/kg	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
PAH 17 Total	mg/kg	0.15967	0.01579	0.00302		0.01268	0.00392	<0.00273		0.00741
Benzo(b)fluoranthene	mg/kg	0.00901	0.00012	0.00032		0.00029	0.00009	0.00017		<0.00008
Benzo(k)fluoranthene	mg/kg	0.0035	<0.00008	0.00012		0.00011	<0.00008	<0.00008		<0.00008

Sample ID		**C.3.30.6MONTH - Leachate A1 (i)**	**C.3.30.6MONTH - Leachate A2 (i)**	**C.3.30.6MONTH - Leachate A3 (i)**		**C.3.30.6MONTH - Leachate B1 (i)**	**C.3.30.6MONTH - Leachate B2 (i)**	**C.3.30.6MONTH - Leachate B3 (i)**		**C.3.30.6MONTH - Leachate C1**
Site		**C**	**C**	**C**		**C**	**C**	**C**		**C**
Sample		**C3**	**C3**	**C3**		**C3**	**C3**	**C3**		**C3**
Subsample		**A1**	**A2**	**A3**		**B1**	**B2**	**B3**		**C1**
Preparation		**Fine Powder - D&C**	**As Received**	**BS12457 95%<4mm**		**Fine Powder - D&C**	**As Received**	**BS12457 95%<4mm**		**As Received**
Aggregate Material		**Concrete**	**Concrete**	**Concrete**		**Concrete**	**Concrete**	**Concrete**		**Concrete**
Aggregate Size		**30mm**	**30mm**	**30mm**		**30mm**	**30mm**	**30mm**		**30mm**
Time in Stockpile		**6 Months**	**6 Months**	**6 Months**		**6 Months**	**6 Months**	**6 Months**		**6 Months**
Carbonisation Time		**0 weeks**	**3 weeks**	**6 weeks**		**0 weeks**	**3 weeks**	**6 weeks**		**0 weeks**
Determinand	**Unit**									
Naphthalene	mg/kg	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
Acenaphthylene	mg/kg	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		0.00008
Acenaphthene	mg/kg	<0.00005	<0.00005	0.00006		<0.00005	<0.00005	<0.00005		0.00036
Fluorene	mg/kg	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		0.00008
Phenanthrene	mg/kg	0.0001	<0.00005	0.00022		0.00009	<0.00005	<0.00005		0.00013
Anthracene	mg/kg	<0.00005	<0.00005	0.00007		<0.00005	<0.00005	<0.00005		<0.00005
Fluoranthene	mg/kg	0.00008	<0.00005	0.00056		0.00008	<0.00005	<0.00005		0.00011
Pyrene	mg/kg	0.00008	<0.00005	0.00053		0.00008	<0.00005	<0.00005		0.0001
Benzo(a)anthracene	mg/kg	<0.00005	<0.00005	0.00027		<0.00005	<0.00005	<0.00005		<0.00005
Chrysene	mg/kg	<0.00005	<0.00005	0.00036		<0.00005	<0.00005	<0.00005		<0.00005
Benzo(bk)fluoranthene	mg/kg	<0.00008	<0.00008	0.0006		<0.00008	<0.00008	<0.00008		<0.00008
Benzo(a)pyrene	mg/kg	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005
Indeno(123cd)pyrene	mg/kg	<0.00005	<0.00005	0.0002		<0.00005	<0.00005	<0.00005		<0.00005
Dibenzo(ah)anthracene	mg/kg	<0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005		<0.00005
Benzo(ghi)perylene	mg/kg	<0.00005	<0.00005	0.00016		<0.00005	<0.00005	<0.00005		<0.00005
Coronene	mg/kg	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001		<0.001
PAH 17 Total	mg/kg	<0.00273	<0.00273	0.00303		<0.00273	<0.00273	<0.00273		<0.00273
Benzo(b)fluoranthene	mg/kg	<0.00008	<0.00008	0.00043		<0.00008	<0.00008	<0.00008		<0.00008
Benzo(k)fluoranthene	mg/kg	<0.00008	<0.00008	0.00017		<0.00008	<0.00008	<0.00008		<0.00008

Table III-6 - Leachate Samples Screened vs PLVs, 0 Weeks Carbonation Time

All Samples in Table were analysed after 0 weeks Carbonation Time				**Sample ID**	**A.1.6FP.3W - Leachate A1 (i)**	**A.1.6FP.3W - Leachate A1 (ii)**	**A.1.6FP.3W - Leachate B1 (i)**	**A.1.6FP.3W - Leachate B1 (ii)**	**A.1.6FP.3W - Leachate C1**	**A.1.6FP.3W - Leachate C1 (ii)**	**B.1.10.1WK - Leachate A1 (i)**	**B.1.10.1WK - Leachate A1 (ii)**	**B.1.10.1WK - Leachate B1 (i)**
				Preparation	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**Fine Powder - D&C**	**Fine Powder - D&C**	**As Received**	**As Received**	**BS12457 95%<4mm**
				Site	**A**	**A**	**A**	**A**	**A**	**A**	**B**	**B**	**B**
				Aggregrate Material	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Natural**	**Natural**	**Natural**
				Aggregate Size	**6F2**	**6F2**	**6F2**	**6F2**	**6F2**	**6F2**	**<10mm**	**<10mm**	**<10mm**
				Time in Stockpile	**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**	**1 week**	**1 week**	**1 week**
				Sample Type	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
				Sampled Date	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**	**Units**	**LOD**									
Dissolved Aluminium			mg/kg	*0.2*	11.2	9.4	11	11.1	8.6	8.7	4.5	2.1	3.2
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	0.04	0.02	*0.02*	0.02	0.03	0.02	*0.02*	*0.02*	*0.02*
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	0.041	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	0.038	*0.025*
Dissolved Barium	5.1	11	mg/kg	*0.03*	0.22	0.2	0.25	0.21	0.29	0.3	*0.03*	*0.03*	0.04
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	580	733	756	619	1090	1160	105	98	158
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	0.151	0.131	0.435	0.259	0.822	0.822	*0.015*	*0.015*	0.024
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	*0.02*	*0.02*	0.04	0.02	0.14	0.14	*0.02*	0.03	0.06
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	237	192	258	301	267	272	6	7	13
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	0.09	0.081	0.073	0.087	0.063	0.055	0.038	0.019	0.115
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	*0.1*		*0.1*		*0.1*		*0.1*		*0.1*
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	*1*		*1*		*1*		*1*		*1*
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	563	818	601	530	844	849	53	33	127
Chloride	440	950	mg/kg	*3*	5	4	12	6	36	36	11	8	20
Dissolved Organic Carbon	180	400	mg/kg	*20*	30	*20*	*20*	30	50	30	*20*	*20*	*20*

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

Table III-6 - Leachate Samples Screened vs PLVs, 0 Weeks Carbonation Time

All Samples in Table were analysed after 0 weeks Carbonation Time			B.1.10.1WK - Leachate B1 (ii)	B.1.10.1WK - Leachate C1	B.1.10.1WK - Leachate C1 (ii)	B.2.10.4WK - Leachate A1 (i)	B.2.10.4WK - Leachate A1 (ii)	B.2.10.4WK - Leachate B1 (i)	B.2.10.4WK - Leachate B1 (ii)	B.2.10.4WK - Leachate C1	B.2.10.4WK - Leachate C1 (ii)	C.1.30.3DAY - Leachate A1 (i)	C.1.30.3DAY - Leachate A1 (ii)
			BS12457 95%<4mm	Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	Fine Powder - D&C	Fine Powder - D&C	As Received	As Received
			B	B	B	B	B	B	B	B	B	C	C
			Natural	Natural	Natural	Natural	Natural	Natural	Natural	Natural	Natural	Concrete	Concrete
			<10mm	<10mm	<10mm	<10mm	<10mm	<10mm	<10mm	<10mm	<10mm	<30mm	<30mm
			1 week	1 week	1 week	4 weeks	4 weeks	4 weeks	4 weeks	4 weeks	4 weeks	<3 days	<3 days
			Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
			22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022
Determinand	**PLV-A**	**PLV-B**											
Dissolved Aluminium			4.1	1.6	1.8	3.4	2.1	2.1	2.6	0.6	0.7	5	4.3
Dissolved Antimony	0.17	0.37	0.02	0.02	0.02	0.02	0.03	0.04	0.03	0.02	0.03	0.02	0.02
Dissolved Arsenic	0.063	0.063	0.027	0.025	0.045	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Dissolved Barium	5.1	11	0.05	0.04	0.03	0.03	0.03	0.05	0.06	0.08	0.08	1.04	1.04
Dissolved Cadmium	0.0074	0.0074	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Dissolved Calcium			201	112	103	83	85	182	193	229	226	2190	2210
Dissolved Chromium	0.25	0.54	0.03	0.019	0.017	0.015	0.015	0.015	0.015	0.017	0.019	0.306	0.285
Dissolved Copper	7.3	16	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.17	0.11
Dissolved Lead	<0.05	0.078	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dissolved Mercury	0.0057	0.0057	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dissolved Molybdenum	0.28	0.6	0.07	0.09	0.1	0.02	0.02	0.04	0.03	0.1	0.1	0.06	0.06
Dissolved Nickel	0.069	0.15	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Dissolved Potassium			15	20	18	4	7	12	13	17	19	260	259
Dissolved Selenium	0.15	0.3	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Dissolved Vanadium	1	2.2	0.116	0.075	0.062	0.03	0.019	0.058	0.065	0.064	0.054	0.015	0.016
Dissolved Zinc	0.33	0.71	0.03	0.03	0.03	0.03	0.03	0.03	0.07	0.03	0.03	0.03	0.03
Phenol	<0.1	<0.1		0.1		0.1		0.1		0.1		0.1	
Total Speciated Phenols HPLC	<0.1	<0.1		1		1		1		1		1	
Fluoride	4.2	9.1	3	5	3	3	3	3	3	4	4	3	3
Sulphate as SO4	1000	2200	147	121	116	42	45	302	262	422	436	237	354
Chloride	440	950	19	35	33	3	3	8	4	24	23	46	49
Dissolved Organic Carbon	180	400	20	20	20	20	20	20	30	30	20	60	90

Key

0.131	Determinand concentration exceeds Met
0.03	Determinand concentration is less than t
0.259	Determinand concentration exceeds the
0.822	Determinand concentration exceeds the

Table III-6 - Leachate Samples Screened vs PLVs, 0 Weeks Carbonation Time

All Samples in Table were analysed after 0 weeks Carbonation Time			**C.1.30.3DAY - Leachate B1 (i)**	**C.1.30.3DAY - Leachate B1 (ii)**	**C.1.30.3DAY - Leachate C1**	**C.1.30.3DAY - Leachate C1 (ii)**	**C.2.30.1WK - Leachate A1 (i)**	**C.2.30.1WK - Leachate A1 (ii)**	**C.2.30.1WK - Leachate B1 (i)**	**C.2.30.1WK - Leachate B1 (ii)**	**C.2.30.1WK - Leachate C1**	**C.2.30.1WK - Leachate C1 (ii)**
			BS12457 95%<4mm	**BS12457 95%<4mm**	**Fine Powder - D&C**	**Fine Powder - D&C**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**Fine Powder - D&C**	**Fine Powder - D&C**
			C	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**
			Concrete	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
			<30mm	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**
			<3 days	**<3 days**	**<3 days**	**<3 days**	**1 week**	**1 week**	**1 week**	**1 week**	**1 week**	**1 week**
			Leachate	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
			22/11/2022	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**										
Dissolved Aluminium			4.8	3.6	5.8	6.8	5.7	2.6	6	4.7	3.8	3.7
Dissolved Antimony	0.17	0.37	*0.02*	*0.02*	0.03	*0.02*	0.03	*0.02*	*0.02*	0.03	*0.02*	0.03
Dissolved Arsenic	0.063	0.063	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*
Dissolved Barium	5.1	11	1.11	1.13	3.66	3.58	0.27	0.42	0.39	0.42	0.4	0.4
Dissolved Cadmium	0.0074	0.0074	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			2430	2720	4200	4200	1490	2670	1500	1640	1750	1770
Dissolved Chromium	0.25	0.54	0.261	0.288	0.185	0.194	0.399	0.465	0.465	0.476	0.803	0.779
Dissolved Copper	7.3	16	*0.07*	*0.07*	*0.07*	*0.07*	0.08	0.1	0.08	0.08	*0.07*	0.07
Dissolved Lead	<0.05	0.078	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.15	0.14
Dissolved Nickel	0.069	0.15	0.02	0.02	*0.02*	*0.02*	*0.02*	0.02	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			184	199	235	255	121	132	133	139	181	178
Dissolved Selenium	0.15	0.3	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	*0.015*	*0.015*	*0.015*	*0.015*	0.134	0.112	0.051	0.04	0.038	0.036
Dissolved Zinc	0.33	0.71	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	*0.1*		*0.1*		*0.1*		*0.1*		*0.1*	
Total Speciated Phenols HPLC	<0.1	<0.1	*1*		*1*		*1*		*1*		*1*	
Fluoride	4.2	9.1	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	228	246	17	18	2150	4270	559	769	648	712
Chloride	440	950	52	61	66	68	39	44	39	49	71	66
Dissolved Organic Carbon	180	400	50	50	60	50	40	30	30	40	100	100

Key

0.131	Determinand concentration exceeds Met
0.03	Determinand concentration is less than t
0.259	Determinand concentration exceeds the
0.822	Determinand concentration exceeds the

Table III-6 - Leachate Samples Screened vs PLVs, 0 Weeks Carbonation Time

All Samples in Table were analysed after 0 weeks Carbonation Time			**C.3.30.6MONTH - Leachate A1 (i)**	**C.3.30.6MONTH - Leachate A1 (ii)**	**C.3.30.6MONTH - Leachate B1 (i)**	**C.3.30.6MONTH - Leachate B1 (ii)**	**C.3.30.6MONTH - Leachate C1**	**C.3.30.6MONTH - Leachate C1 (ii)**
			As Received	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**Fine Powder - D&C**	**Fine Powder - D&C**
			C	**C**	**C**	**C**	**C**	**C**
			Concrete	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
			<30mm	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**
			6 months	**6 months**	**6 months**	**6 months**	**6 months**	**6 months**
			Leachate	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
			22/11/2022	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**						
Dissolved Aluminium			8.2	9.2	4.8	4.9	2	2
Dissolved Antimony	0.17	0.37	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	0.02
Dissolved Arsenic	0.063	0.063	*0.025*	*0.025*	*0.025*	0.028	*0.025*	*0.025*
Dissolved Barium	5.1	11	1.38	1.12	1.74	1.74	2.76	2.8
Dissolved Cadmium	0.0074	0.0074	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			3630	3220	4970	4910	7430	7970
Dissolved Chromium	0.25	0.54	0.104	0.111	0.093	0.096	0.114	0.108
Dissolved Copper	7.3	16	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	*0.02*	*0.02*	*0.02*	*0.02*	0.02	*0.02*
Dissolved Nickel	0.069	0.15	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			76	63	88	85	222	225
Dissolved Selenium	0.15	0.3	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*
Dissolved Zinc	0.33	0.71	*0.03*	*0.03*	*0.03*	0.03	*0.03*	*0.03*
Phenol	<0.1	<0.1	*0.1*		*0.1*		*0.1*	
Total Speciated Phenols HPLC	<0.1	<0.1	*1*		*1*		*1*	
Fluoride	4.2	9.1	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	21	27	16	7	*5*	10
Chloride	440	950	20	18	29	28	43	46
Dissolved Organic Carbon	180	400	*20*	*20*	20	20	40	40

Key

0.131	Determinand concentration exceeds Met
0.03	Determinand concentration is less than t
🟩 0.259	Determinand concentration exceeds the
🟥 0.822	Determinand concentration exceeds the

Table III-7 - Leachate Samples Screened vs PLVs, 3 Weeks Carbonation Time

All Samples in Table were analysed after 3 weeks Carbonation Time			Sample ID		A.1.6FP.3W - Leachate A1 (i)	A.1.6FP.3W - Leachate A1 (ii)	A.1.6FP.3W - Leachate B1 (i)	A.1.6FP.3W - Leachate B1 (ii)	B.1.10.1WK - Leachate A1 (i)	B.1.10.1WK - Leachate A1 (ii)	B.1.10.1WK - Leachate B1 (i)	B.1.10.1WK - Leachate B1 (ii)	B.2.10.4WK - Leachate A1 (i)
			Preparation		As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	As Received
			Site		A	A	A	A	B	B	B	B	B
			Aggregate Material		Concrete	Concrete	Concrete	Concrete	Natural	Natural	Natural	Natural	Natural
			Aggregate Size		6F2	6F2	6F2	6F2	<10mm	<10mm	<10mm	<10mm	<10mm
			Time in Stockpile		3 weeks	3 weeks	3 weeks	3 weeks	1 week	1 week	1 week	1 week	4 weeks
			Sample Type		Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate	Leachate
			Sampled Date		22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022
Determinand	**PLV-A**	**PLV-B**	**Units**	**LOD**									
Dissolved Aluminium			mg/kg	*0.2*	0.7	0.5	0.8	1	4	3	1.1	0.9	2.2
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	0.06	0.06	0.04	0.05	*0.02*	*0.02*	*0.02*	*0.02*	0.03
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	0.03
Dissolved Barium	5.1	11	mg/kg	*0.03*	0.18	0.1	0.11	0.1	*0.03*	*0.03*	0.04	0.04	*0.03*
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	429	490	517	539	74	89	106	105	93
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	0.138	0.179	0.461	0.472	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	0.13	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	*0.02*	0.03	0.05	0.05	*0.02*	*0.02*	0.05	0.05	0.04
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	131	153	144	152	6	10	12	12	9
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	0.193	0.227	0.218	0.228	0.03	0.066	0.057	0.052	0.044
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	0.1	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	*1*	-	*1*	-	*1*	-	*1*	-	*1*
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	917	1010	847	844	22	76	91	217	72
Chloride	440	950	mg/kg	*3*	*3*	*3*	11	11	*3*	*3*	4	*3*	*3*
Dissolved Organic Carbon	180	400	mg/kg	*20*	40	*20*	40	20	30	*20*	30	*20*	30

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
🟩 0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
🟥 0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

Note:* Rerun value shown, first fun of this sample obtained a sulphate result of 4430 mg/kg. High original values may be due to laboratory error/ uncertainty and have not been considered in analysis.

Table III-7 - Leachate Samples Screened vs PLVs, 3 Weeks Carbonation Time

All Samples in Table were analysed after 3 weeks Carbonation Time				**Sample ID**	**B.2.10.4WK - Leachate A1 (ii)**	**B.2.10.4WK - Leachate B1 (i)**	**B.2.10.4WK - Leachate B1 (ii)**	**C.1.30.3DAY - Leachate A1 (i)**	**C.1.30.3DAY - Leachate A1 (ii)**	**C.1.30.3DAY - Leachate B1 (i)**	**C.1.30.3DAY - Leachate B1 (ii)**	**C.2.30.1WK - Leachate A1 (i)**
				Preparation	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**
				Site	**B**	**B**	**B**	**C**	**C**	**C**	**C**	**C**
				Aggregate Material	**Natural**	**Natural**	**Natural**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
				Aggregate Size	**<10mm**	**<10mm**	**<10mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**
				Time in Stockpile	**4 weeks**	**4 weeks**	**4 weeks**	**<3 days**	**<3 days**	**<3 days**	**<3 days**	**1 week**
				Sample Type	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
				Sampled Date	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**	**Units**	**LOD**								
Dissolved Aluminium			mg/kg	*0.2*	1.8	0.8	1	7.1	13.3	8.8	8.4	1.3
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	0.04	0.04	0.04
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*
Dissolved Barium	5.1	11	mg/kg	*0.03*	0.04	0.11	0.07	0.31	0.18	0.12	0.11	0.32
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	86	309	152	565	981	683	650	2550
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	*0.015*	*0.015*	*0.015*	0.134	0.124	0.202	0.252	0.167
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	0.03	0.07	0.07	*0.02*	*0.02*	0.03	0.03	0.03
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	12	14	13	133	108	129	155	93
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	0.028	0.017	0.026	0.144	0.092	0.2	0.209	0.175
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	0.04	*0.03*	0.04	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	-	*1*	-	*1*	-	*1*	-	*1*
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	36	641	223	425*	384	624	703	5540
Chloride	440	950	mg/kg	*3*	*3*	*3*	*3*	11	18	29	32	14
Dissolved Organic Carbon	180	400	mg/kg	*20*	*20*	30	*20*	30	20	40	30	40

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
🟩 0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
🟥 0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

Note:* Rerun value shown, first fun of this sample obtained a sulphate result of 4430 mg/kg. High original values may be due to laboratory error/ uncertainty and have not been considered in analysis.

Table III-7 - Leachate Samples Screened vs PLVs, 3 Weeks Carbonation Time

All Samples in Table were analysed after 3 weeks Carbonation Time				**Sample ID**	**C.2.30.1WK - Leachate A1 (ii)**	**C.2.30.1WK - Leachate B1 (i)**	**C.2.30.1WK - Leachate B1 (ii)**	**C.3.30.6MONTH - Leachate A1 (i)**	**C.3.30.6MONTH - Leachate A1 (ii)**	**C.3.30.6MONTH - Leachate B1 (i)**	**C.3.30.6MONTH - Leachate B1 (ii)**
				Preparation	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**
				Site	**C**	**C**	**C**	**C**	**C**	**C**	**C**
				Aggregate Material	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
				Aggregate Size	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**
				Time in Stockpile	**1 week**	**1 week**	**1 week**	**6 months**	**6 months**	**6 months**	**6 months**
				Sample Type	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
				Sampled Date	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**	Units	LOD							
Dissolved Aluminium			mg/kg	*0.2*	2.2	3.4	3.5	19.7	20.5	21.3	21.4
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	0.04	0.06	0.03	*0.02*	0.04	*0.02*	0.03
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*
Dissolved Barium	5.1	11	mg/kg	*0.03*	0.11	0.09	0.1	0.13	0.08	0.13	0.13
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	1140	722	807	839	527	713	744
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	0.233	0.388	0.392	0.189	0.096	0.16	0.168
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	0.03	0.04	0.05	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	89	97	100	92	74	85	90
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	0.222	0.264	0.26	0.055	0.055	0.046	0.043
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*	-
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	-	*1*	-	*1*	-	*1*	-
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	2140	1110	1280	279	109	132	123
Chloride	440	950	mg/kg	*3*	12	30	28	12	6	14	16
Dissolved Organic Carbon	180	400	mg/kg	*20*	*20*	40	20	40	*20*	30	20

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
🟩 0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
🟥 0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

Note:* Rerun value shown, first fun of this sample obtained a sulphate result of 4430 mg/kg. High original values may be due to laboratory error/ uncertainty and have not been considered in analysis.

All Samples in Table were analysed after 6 weeks Carbonation Time				**Sample ID**	**A.1.6FP.3W - Leachate A3 (i)**	**A.1.6FP.3W - Leachate A3 (ii)**	**A.1.6FP.3W - Leachate B3 (i)**	**A.1.6FP.3W - Leachate B3 (ii)**	**B.1.10.1WK - Leachate A3 (i)**	**B.1.10.1WK - Leachate A3 (ii)**	**B.1.10.1WK - Leachate B3 (i)**	**B.1.10.1WK - Leachate B3 (ii)**	**B.2.10.4WK - Leachate A3 (i)**
				Preparation	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**
				Site	**A**	**A**	**A**	**A**	**B**	**B**	**B**	**B**	**B**
				Aggregrate Material	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Natural**	**Natural**	**Natural**	**Natural**	**Natural**
				Aggregate Size	**6F2**	**6F2**	**6F2**	**6F2**	**<10mm**	**<10mm**	**<10mm**	**<10mm**	**<10mm**
				Time in Stockpile	**3 weeks**	**3 weeks**	**3 weeks**	**3 weeks**	**1 week**	**1 week**	**1 week**	**1 week**	**4 weeks**
				Sample Type	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
				Sampled Date	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**	**Units**	**LOD**									
Dissolved Aluminium			mg/kg	*0.2*	0.9	0.5	1.1	0.4	2.7	2.3	1.5	1.6	2.7
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	0.04	0.05	*0.02*	0.04	*0.02*	*0.02*	*0.02*	*0.02*	0.03
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	0.032	*0.025*	0.033	*0.025*	*0.025*
Dissolved Barium	5.1	11	mg/kg	*0.03*	0.09	0.07	0.05	0.07	*0.03*	*0.03*	0.03	*0.03*	*0.03*
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	305	258	204	320	82	76	89	83	75
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	0.075	0.05	0.066	0.115	*0.015*	*0.015*	*0.015*	*0.015*	*0.015*
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	0.03	0.03	*0.02*
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	75	75	62	72	3	6	6	8	5
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	0.194	0.178	0.133	0.156	0.022	0.035	0.042	0.045	0.022
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	*0.03*	0.04	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	*1*	-	*1*	-	*1*	-	*1*	-	*1*
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	582	432	302	510	13	23	35	28	21
Chloride	440	950	mg/kg	*3*	*3*	*3*	6	*3*	*3*	*3*	*3*	*3*	*3*
Dissolved Organic Carbon	180	400	mg/kg	*20*	30	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
🟩 0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
🟥 0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

*Rerun values shown. Original run for sulphate was 14,300 mg/kg and for calcium was 7,680 mg/kg. High original values may be due to laboratory error/ uncertainty and have not been considered in analysis.

**Rerun value shown. Original run for arsenic was 0.095 mg/kg. High original values may be due to laboratory error/ uncertainty and have not been considered in analysis.

Table III-8 - Leachate Samples Screened vs PLVs, 6 Weeks Carbonation Time

All Samples in Table were analysed after 6 weeks Carbonation Time			**Sample ID**		**B.2.10.4WK - Leachate A3 (ii)**	**B.2.10.4WK - Leachate B3 (i)**	**B.2.10.4WK - Leachate B3 (ii)**	**C.1.30.3DAY - Leachate A3 (i)**	**C.1.30.3DAY - Leachate A3 (ii)**	**C.1.30.3DAY - Leachate B3 (i)**	**C.1.30.3DAY - Leachate B3 (ii)**	**C.2.30.1WK - Leachate A3 (i)**
			Preparation		**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**
			Site		**B**	**B**	**B**	**C**	**C**	**C**	**C**	**C**
			Aggregrate Material		**Natural**	**Natural**	**Natural**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
			Aggregate Size		**<10mm**	**<10mm**	**<10mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**
			Time in Stockpile		**4 weeks**	**4 weeks**	**4 weeks**	**<3 days**	**<3 days**	**<3 days**	**<3 days**	**1 week**
			Sample Type		**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
			Sampled Date		**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**	**Units**	**LOD**								
Dissolved Aluminium			mg/kg	*0.2*	2.1	1.7	1.9	8	3.2	4.3	5.4	1.6
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	0.02	0.03	*0.02*	*0.02*	*0.02*	0.03	0.02	*0.02*
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	*0.025*	*0.025*	*0.025*	0.032	*0.025*	*0.025*	*0.025*	*0.025*
Dissolved Barium	5.1	11	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	0.09	0.55	0.06	0.06	0.06
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	91	91	80	473	379*	414	409	536
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	*0.015*	*0.015*	*0.015*	0.071	0.088	0.125	0.105	0.14
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	0.09	0.03	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	7	7	7	66	97	91	88	49
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	*0.015*	0.034	0.025	0.167	0.12	0.202	0.195	0.257
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	-	*1*	-	*1*	-	*1*	-	*1*
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	18	25	18	336	🟩 925*	330	278	867
Chloride	440	950	mg/kg	*3*	*3*	*3*	*3*	5	11	11	12	3
Dissolved Organic Carbon	180	400	mg/kg	*20*	*20*	*20*	*20*	20	*20*	20	*20*	30

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
🟩 0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
🟥 0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

*Rerun values shown. Original run for sulphate was 14,300 mg/kg and for calcium was 7,680 mg/kg. High original values may be du

**Rerun value shown. Original run for arsenic was 0.095 mg/kg. High original values may be due to laboratory error/ uncertainty an

Table III-8 - Leachate Samples Screened vs PLVs, 6 Weeks Carbonation Time

All Samples in Table were analysed after 6 weeks Carbonation Time				Sample ID	C.2.30.1WK - Leachate A3 (ii)	C.2.30.1WK - Leachate B3 (i)	C.2.30.1WK - Leachate B3 (ii)	C.3.30.6MONTH - Leachate A3 (i)	C.3.30.6MONTH - Leachate A3 (ii)	C.3.30.6MONTH - Leachate B3 (i)	C.3.30.6MONTH - Leachate B3 (ii)
				Preparation	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**	**As Received**	**As Received**	**BS12457 95%<4mm**	**BS12457 95%<4mm**
				Site	**C**	**C**	**C**	**C**	**C**	**C**	**C**
				Aggregrate Material	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**	**Concrete**
				Aggregate Size	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**	**<30mm**
				Time in Stockpile	**1 week**	**1 week**	**1 week**	**6 months**	**6 months**	**6 months**	**6 months**
				Sample Type	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**	**Leachate**
				Sampled Date	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Determinand	**PLV-A**	**PLV-B**	**Units**	**LOD**							
Dissolved Aluminium			mg/kg	*0.2*	3.6	1.3	1.6	15.8	20.1	15.8	15.4
Dissolved Antimony	0.17	0.37	mg/kg	*0.02*	*0.02*	0.02	0.02	0.04	*0.02*	0.03	*0.02*
Dissolved Arsenic	0.063	0.063	mg/kg	*0.025*	0.032	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*	*0.025*
Dissolved Barium	5.1	11	mg/kg	*0.03*	0.05	0.04	0.05	0.11	0.1	0.09	0.08
Dissolved Cadmium	0.0074	0.0074	mg/kg	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Dissolved Calcium			mg/kg	*2*	469	382	422	750	631	605	625
Dissolved Chromium	0.25	0.54	mg/kg	*0.015*	0.139	0.129	0.139	0.089	0.112	0.106	0.102
Dissolved Copper	7.3	16	mg/kg	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Dissolved Lead	<0.05	0.078	mg/kg	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*
Dissolved Mercury	0.0057	0.0057	mg/kg	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Dissolved Molybdenum	0.28	0.6	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Nickel	0.069	0.15	mg/kg	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
Dissolved Potassium			mg/kg	*1*	46	49	53	48	58	84	91
Dissolved Selenium	0.15	0.3	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Dissolved Vanadium	1	2.2	mg/kg	*0.015*	0.239	0.295	0.284	0.059	0.107	0.085	0.089
Dissolved Zinc	0.33	0.71	mg/kg	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
Phenol	<0.1	<0.1	mg/kg	*0.1*	-	*0.1*	-	*0.1*	-	*0.1*	-
Total Speciated Phenols HPLC	<0.1	<0.1	mg/kg	*1*	-	*1*	-	*1*	-	*1*	-
Fluoride	4.2	9.1	mg/kg	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*
Sulphate as SO4	1000	2200	mg/kg	*5*	533	511	601	215	219	194	169
Chloride	440	950	mg/kg	*3*	6	*3*	3	5	4	12	11
Dissolved Organic Carbon	180	400	mg/kg	*20*	*20*	20	*20*	*20*	*20*	20	*20*

Key

0.131	Determinand concentration exceeds Method Detection Limit and is below PLV-A and PLV-B
0.03	Determinand concentration is less than the Method Detection Limit
🟩 0.259	Determinand concentration exceeds the Method Detection Limit and PLV-A
🟥 0.822	Determinand concentration exceeds the Method Detection Limit, PLV-A and PLV-B

*Rerun values shown. Original run for sulphate was 14,300 mg/kg and for calcium was 7,680 mg/kg. High original values may be du

**Rerun value shown. Original run for arsenic was 0.095 mg/kg. High original values may be due to laboratory error/ uncertainty an

Table III - 9 - Total Concentration Data Screened vs S-PLV

			Sample ID	A.1.6FP.3W	B.1.10.1WK	B.2.10.4WK	C.1.30.3DAY	C.2.30.1WK	C.3.30.6MONTH
			Site	**A**	**B**	**B**	**C**	**C**	**C**
			Aggregate Material	**Concrete**	**Natural**	**Natural**	**Concrete**	**Concrete**	**Concrete**
			Aggregate Size	**6FP**	**<10mm**	**<10mm**	**<30mm**	**<30mm**	**<30mm**
			Time in Stockpile	**3 weeks**	**1 week**	**4 weeks**	**<3 days**	**1 week**	**6 months**
			Sample Type	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**
			Sampled Date	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**	**22/11/2022**
Test	**S-PLV**	**Units**	**LOD**						
Total Organic Carbon	2.4	%	<0.02	0.49	0.23	0.79	0.15	0.66	0.09
Total BTEX	0.0025	mg/kg	<0.0025	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*	*0.0025*
PCBs (7 Congeners	0.035	mg/kg	<0.035	*0.035*	*0.035*	*0.035*	*0.035*	*0.035*	*0.035*
TPH >C10-C44 (Mineral Oil)	50	mg/kg	<50.4	519	*50.4*	*50.4*	470	107	*50.4*
Total PAHs (17 including Coronene)	2	mg/kg	<0.64	*0.64*	*0.64*	*0.64*	*0.64*	7.05	*0.64*
Chromium VI	2	mg/kg	<0.3	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
Arsenic	40	mg/kg	<0.5	8	10.9	8.2	7.6	8.6	5.3
Lead	310	mg/kg	<5	23	11	10	9	12	9

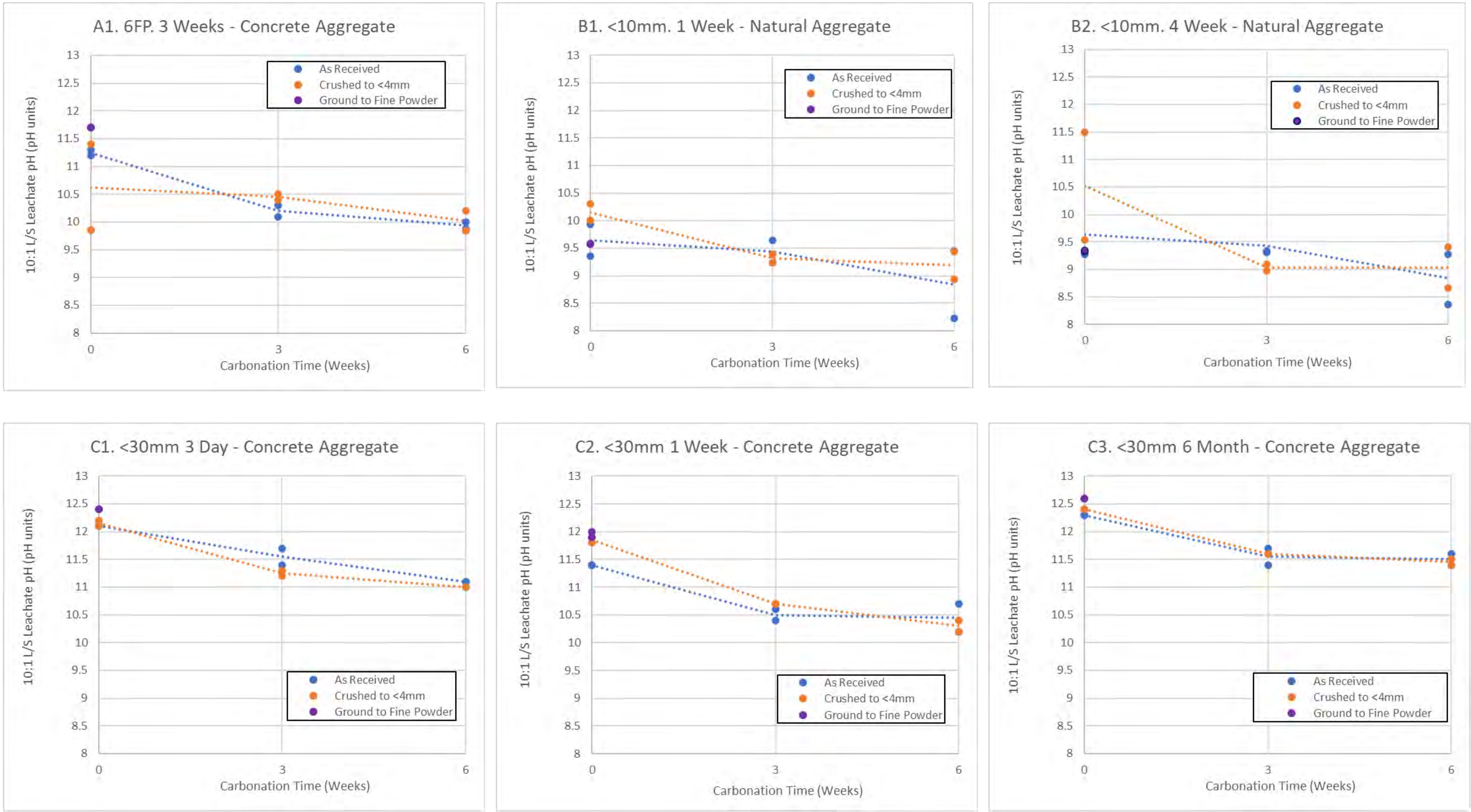
Key

0.131	Determinand concentration exceeds Method Detection Limit and is below S-PLV
0.03	Determinand concentration is less than the Method Detection Limit
0.259	Determinand concentration exceeds the Method Detection Limit and S-PLV

A P P E N D I X

IV

Summary Graphs of Key Results



A1. 6FP. 3 Weeks - Concrete Aggregate

B1. <10mm. 1 Week - Natural Aggregate

B2. <10mm. 4 Week - Natural Aggregate

C1. <30mm 3 Day - Concrete Aggregate

C2. <30mm 1 Week - Concrete Aggregate

C3. <30mm 6 Month - Concrete Aggregate

Figure IV1 – Leachate pH Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

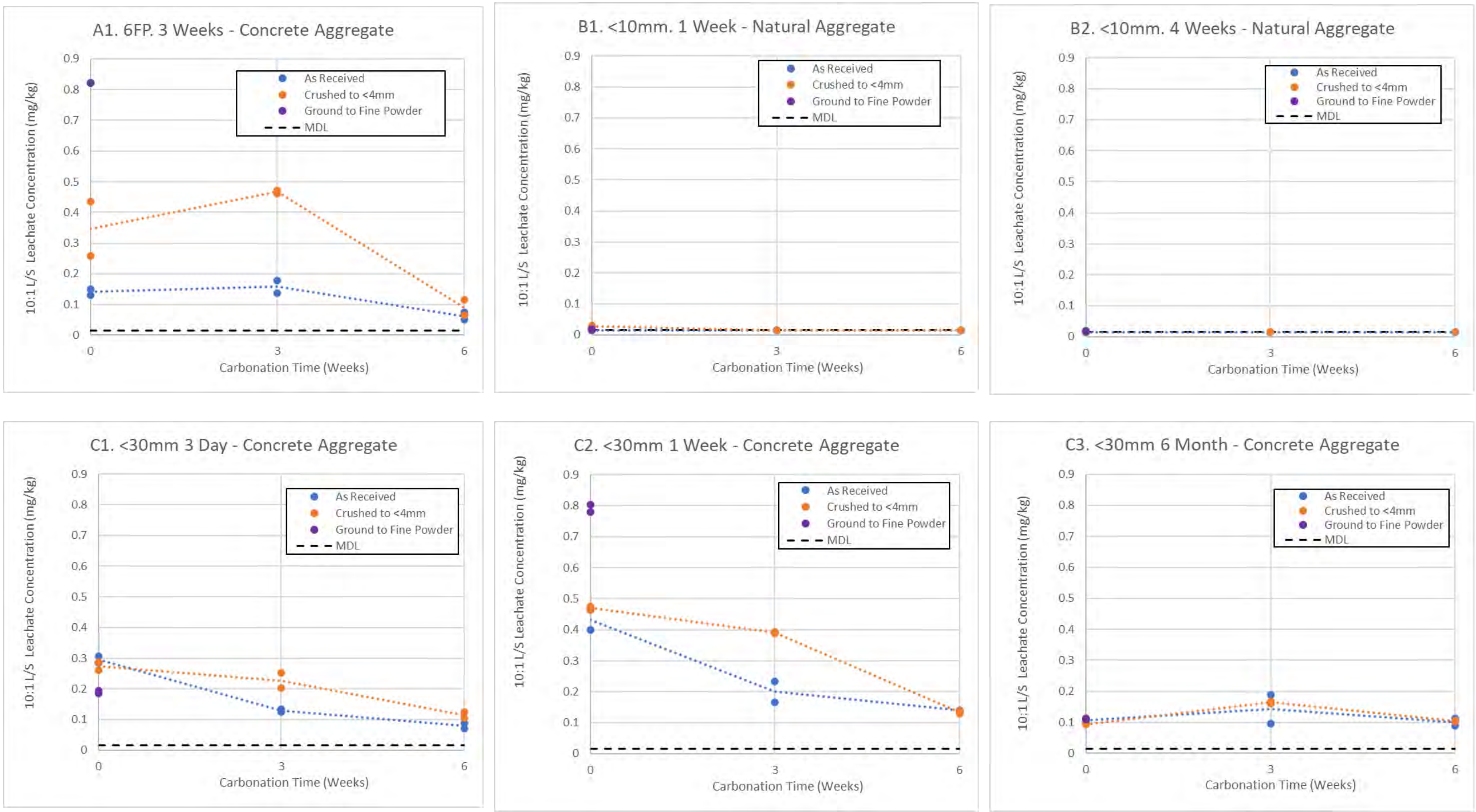


Figure IV2 – Leachate Total Chromium Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

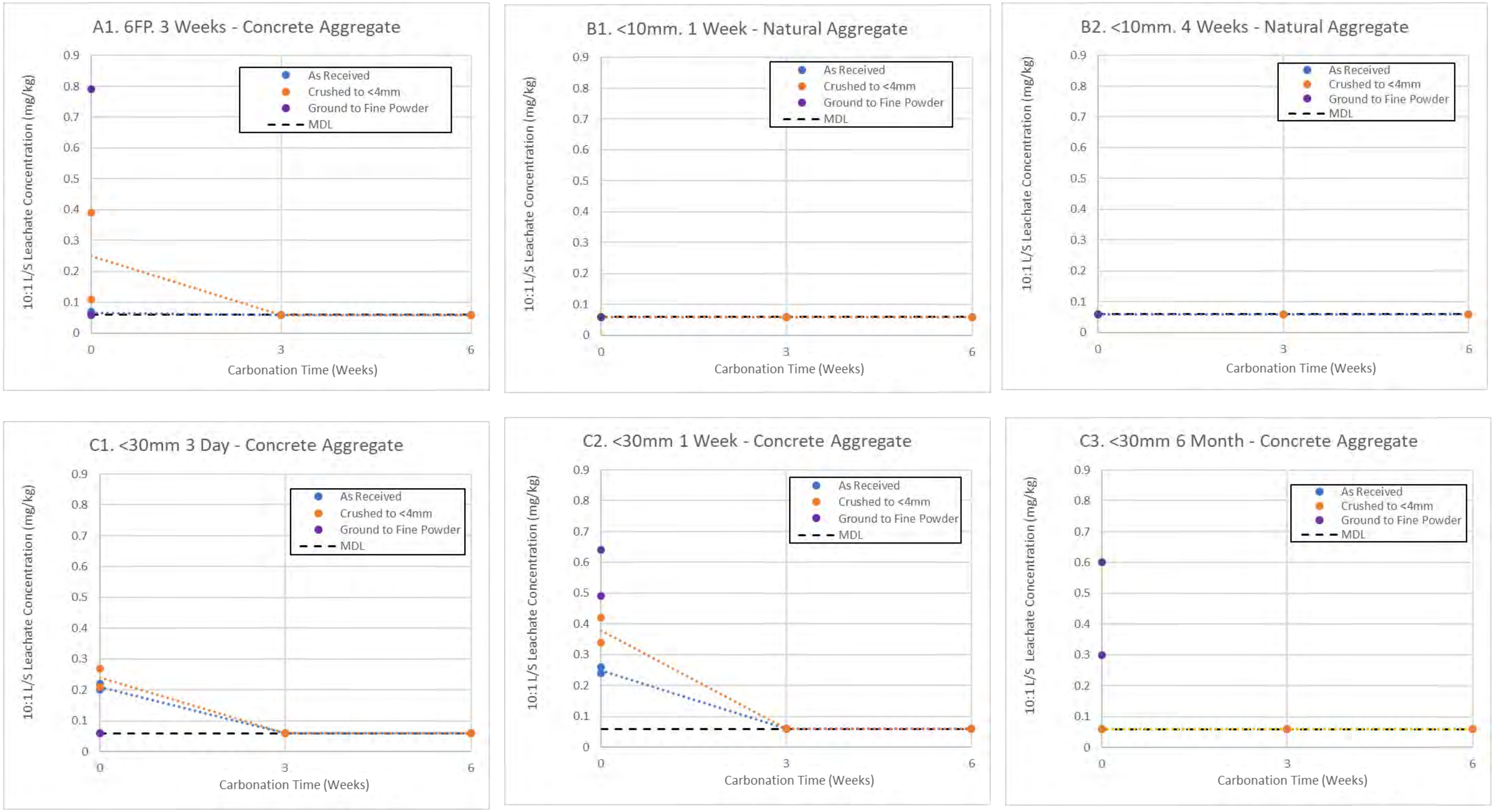


Figure IV3 – Leachate Chromium VI Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

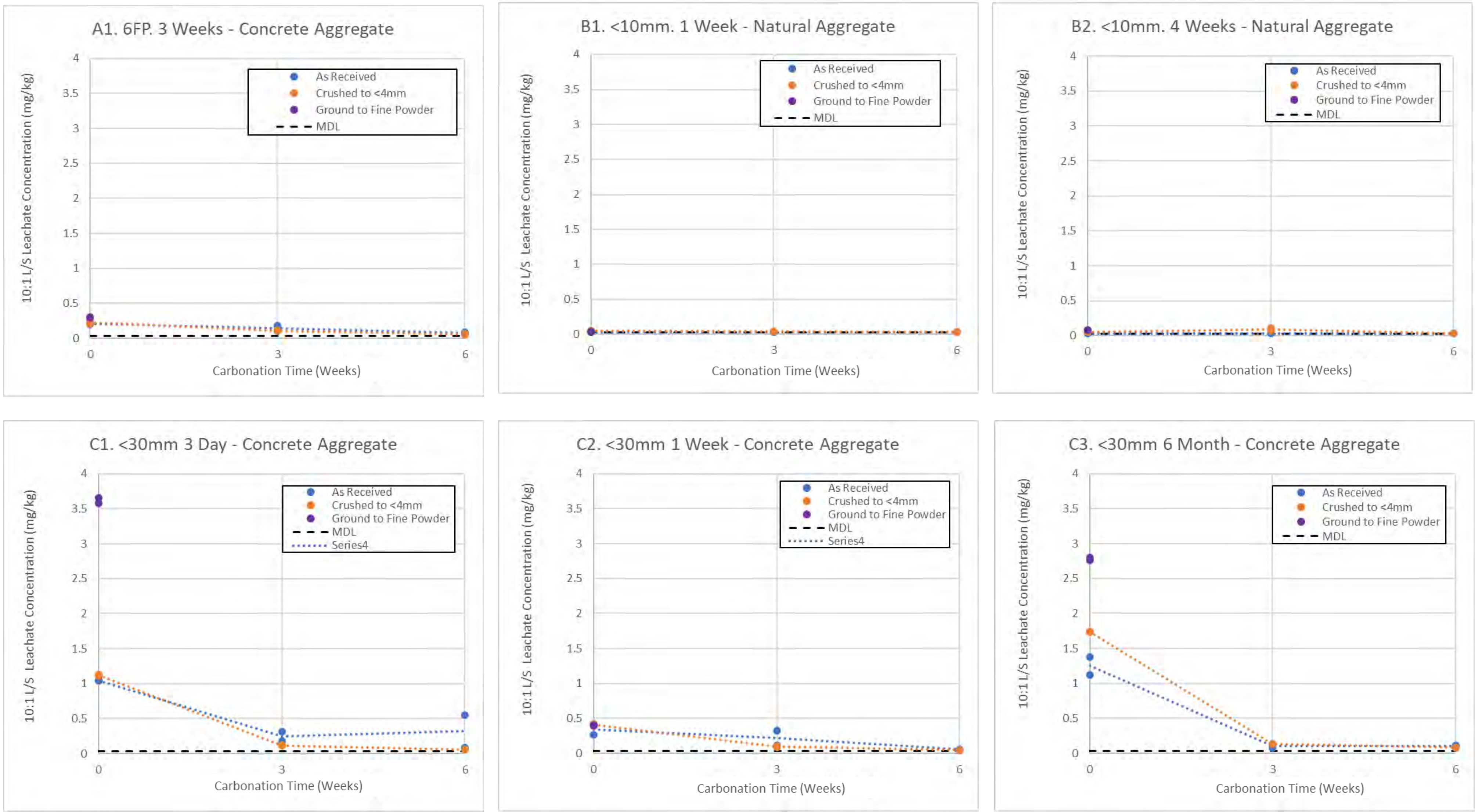


Figure IV4 – Leachate Barium Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

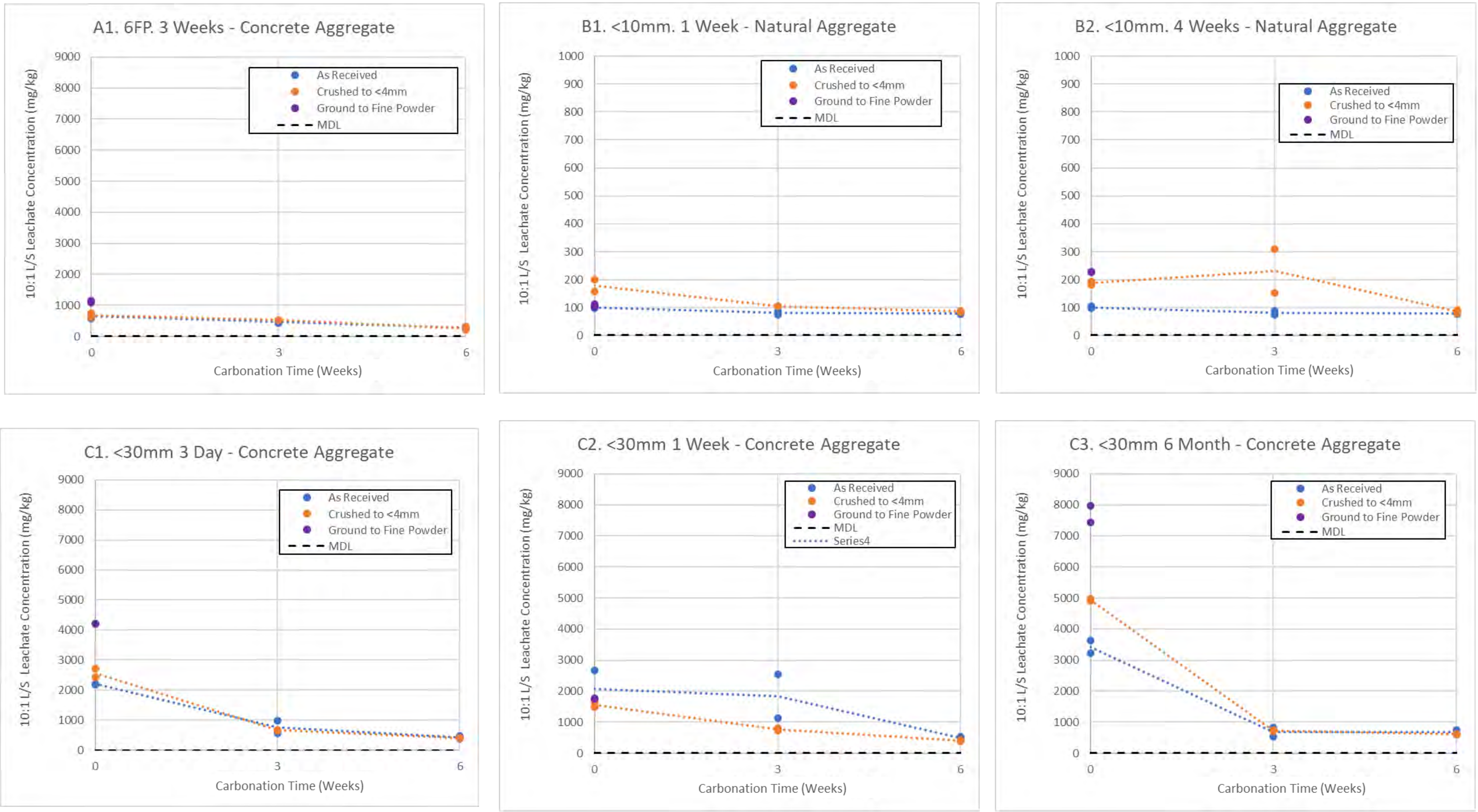


Figure IV5 – Leachate Calcium Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

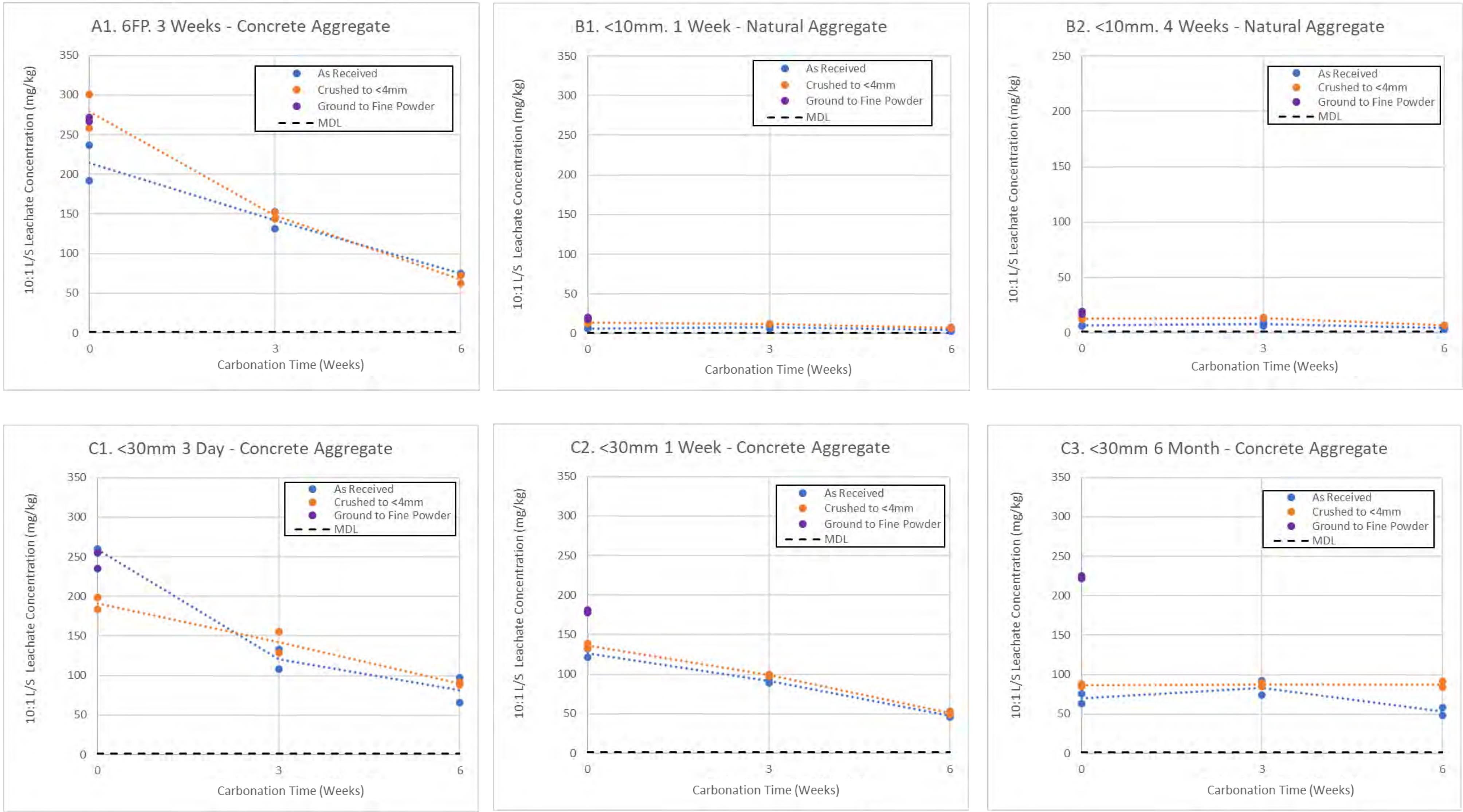


Figure IV6 – Leachate Potassium Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

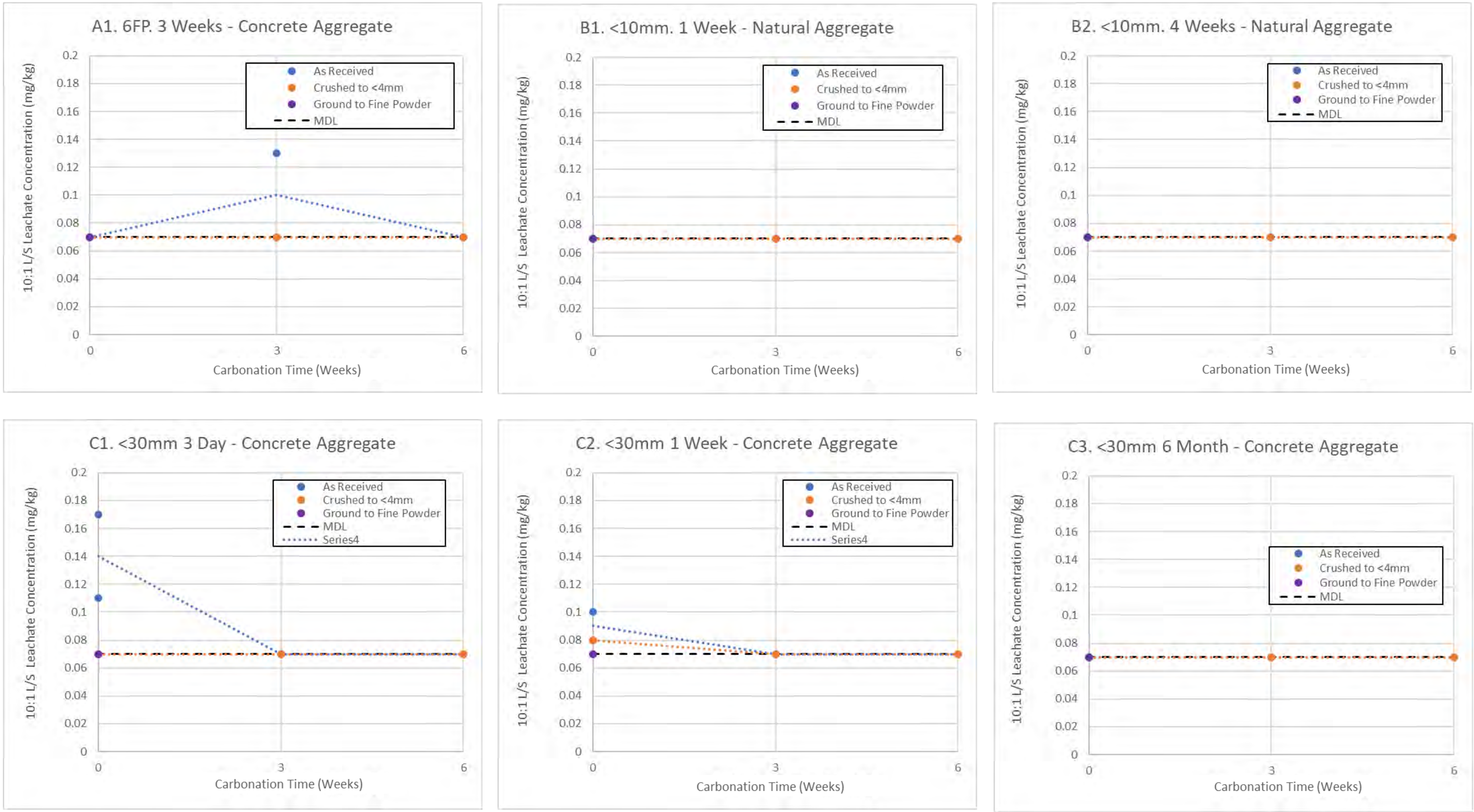


Figure IV7 – Leachate Copper Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

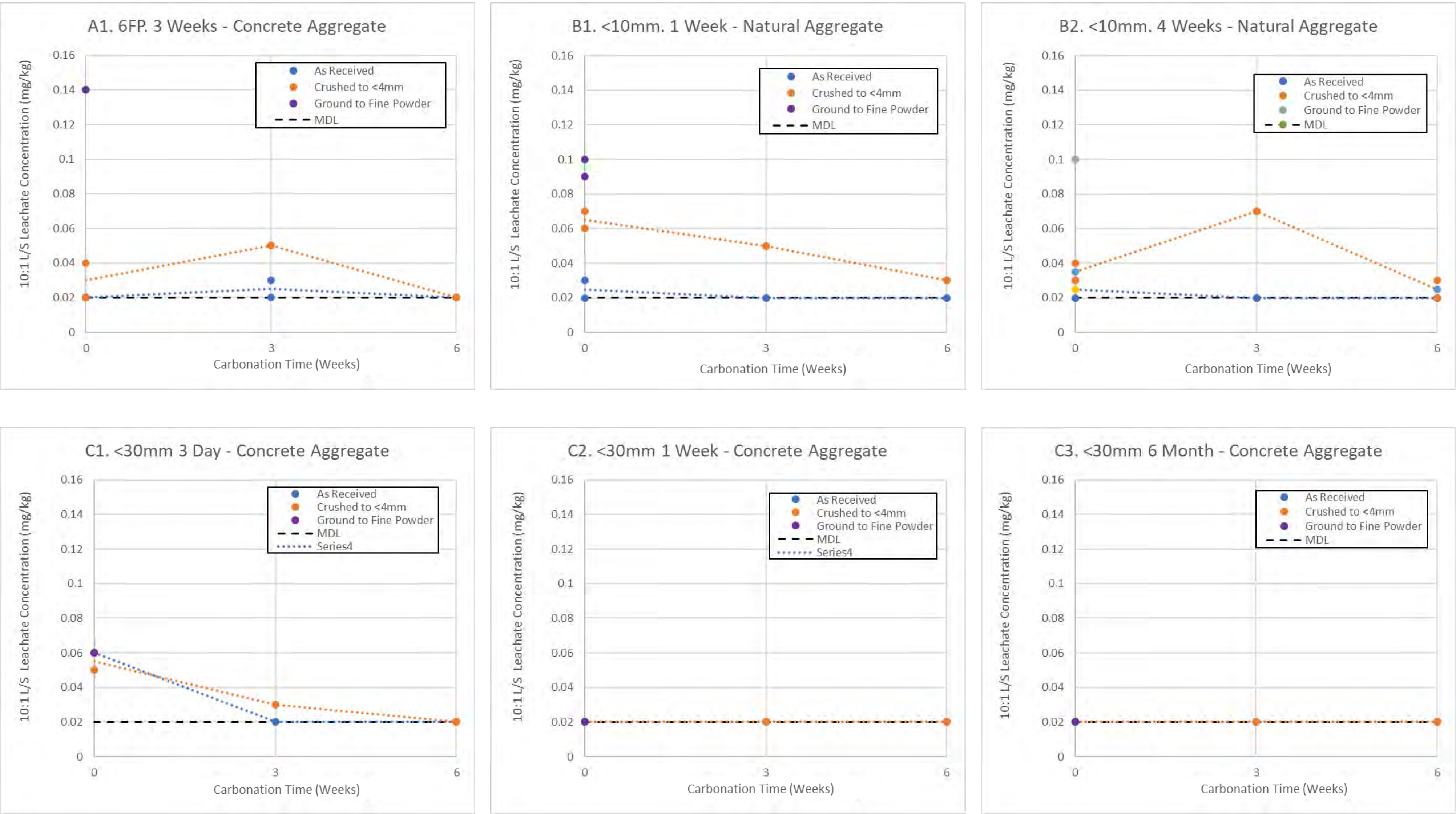
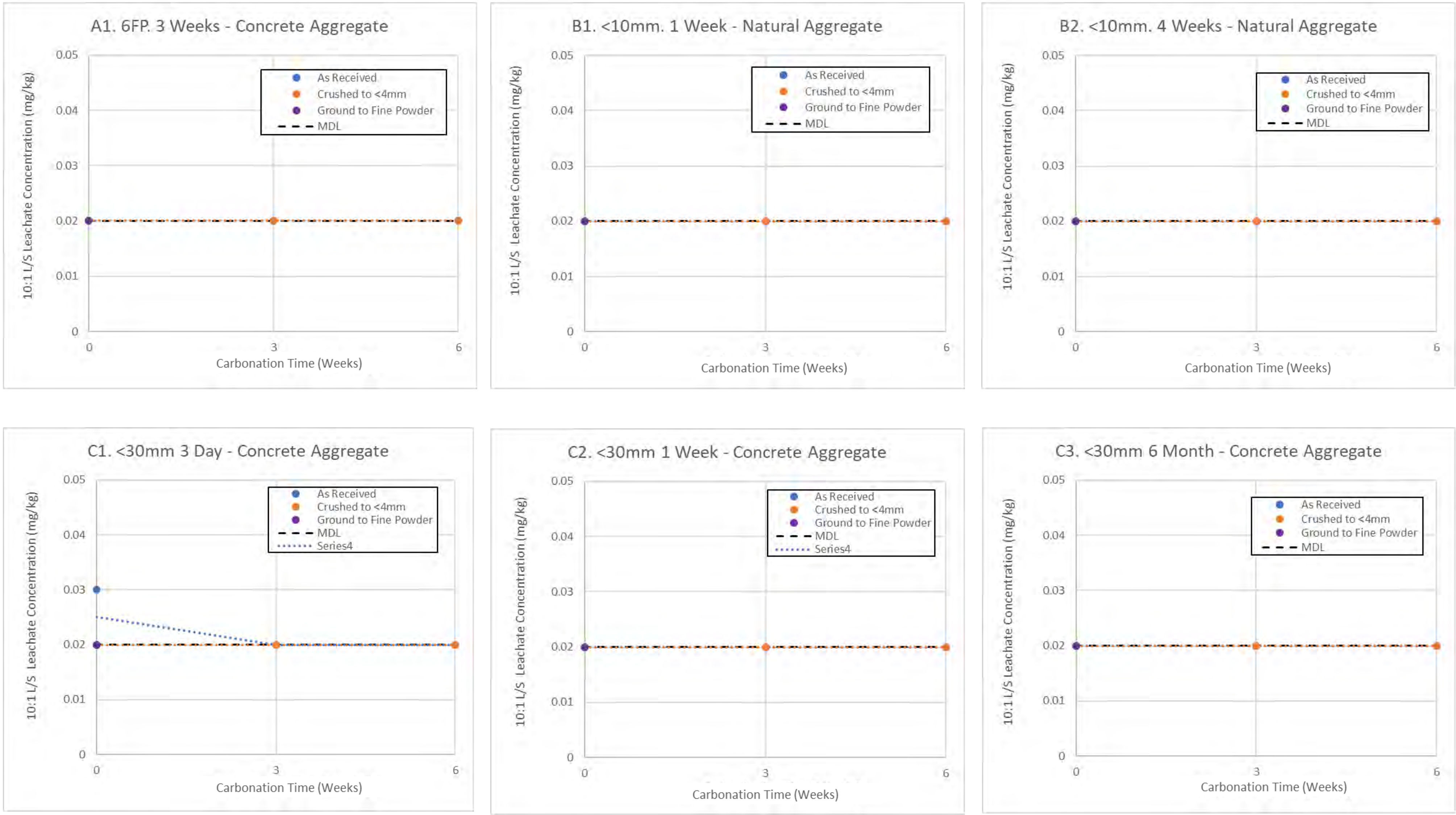


Figure IV8 – Leachate Molybdenum Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type


A1. 6FP. 3 Weeks - Concrete Aggregate

B1. <10mm. 1 Week - Natural Aggregate

B2. <10mm. 4 Weeks - Natural Aggregate

C1. <30mm 3 Day - Concrete Aggregate

C2. <30mm 1 Week - Concrete Aggregate

C3. <30mm 6 Month - Concrete Aggregate

Figure IV9 – Leachate Nickel Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

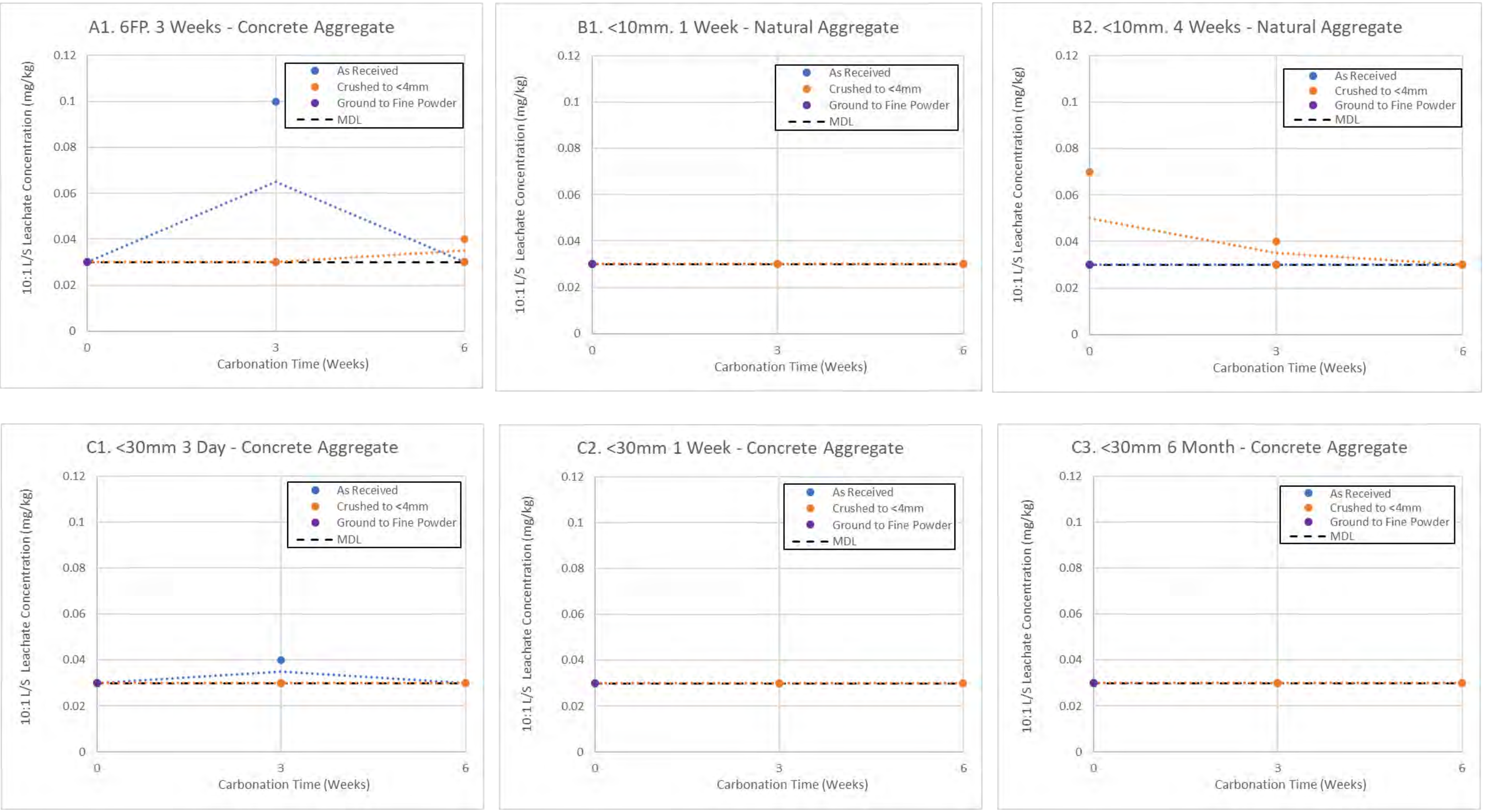
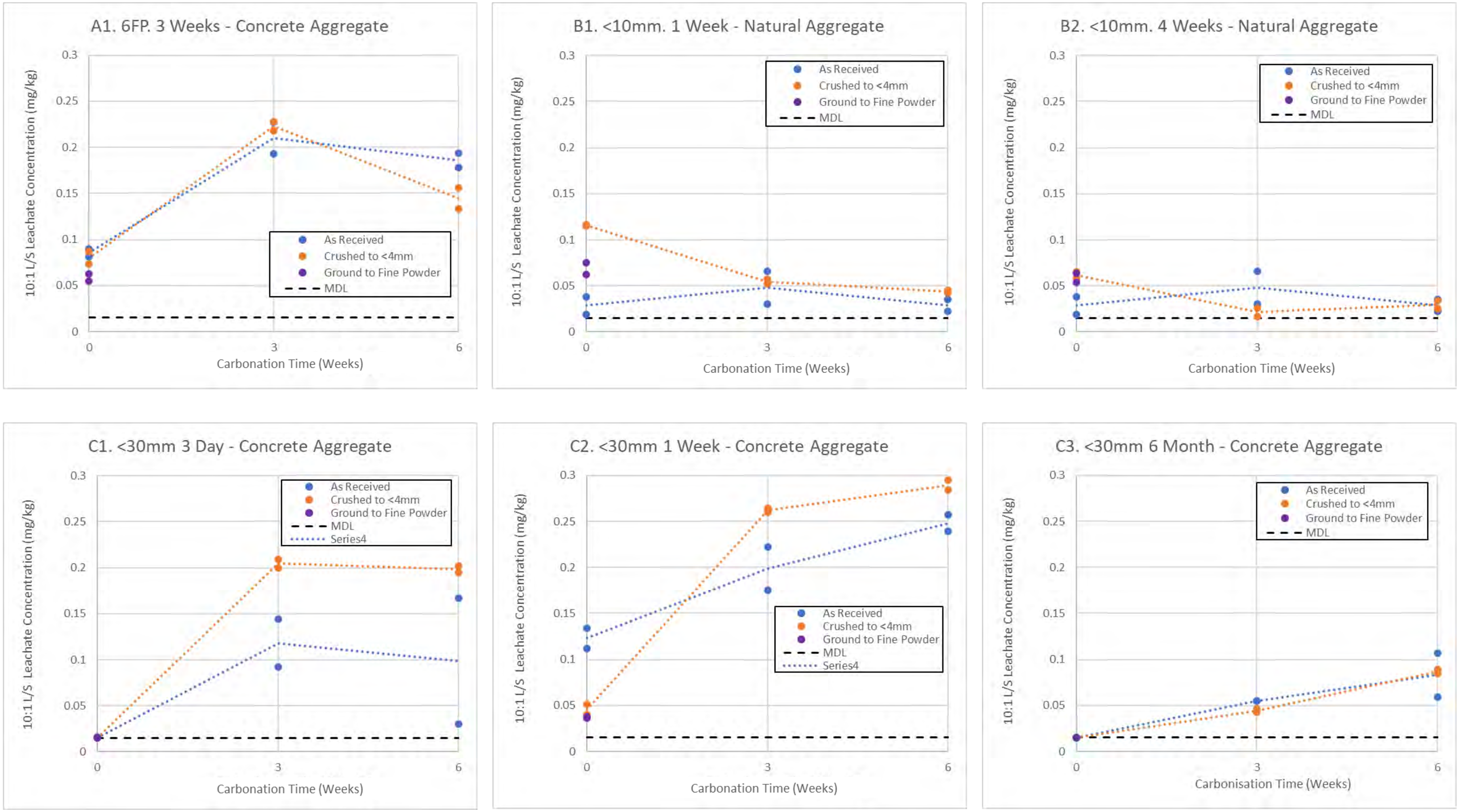


Figure IV10 – Leachate Zinc Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type



A1. 6FP. 3 Weeks - Concrete Aggregate

B1. <10mm. 1 Week - Natural Aggregate

B2. <10mm. 4 Weeks - Natural Aggregate

C1. <30mm 3 Day - Concrete Aggregate

C2. <30mm 1 Week - Concrete Aggregate

C3. <30mm 6 Month - Concrete Aggregate

Figure IV11 – Leachate Vanadium Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

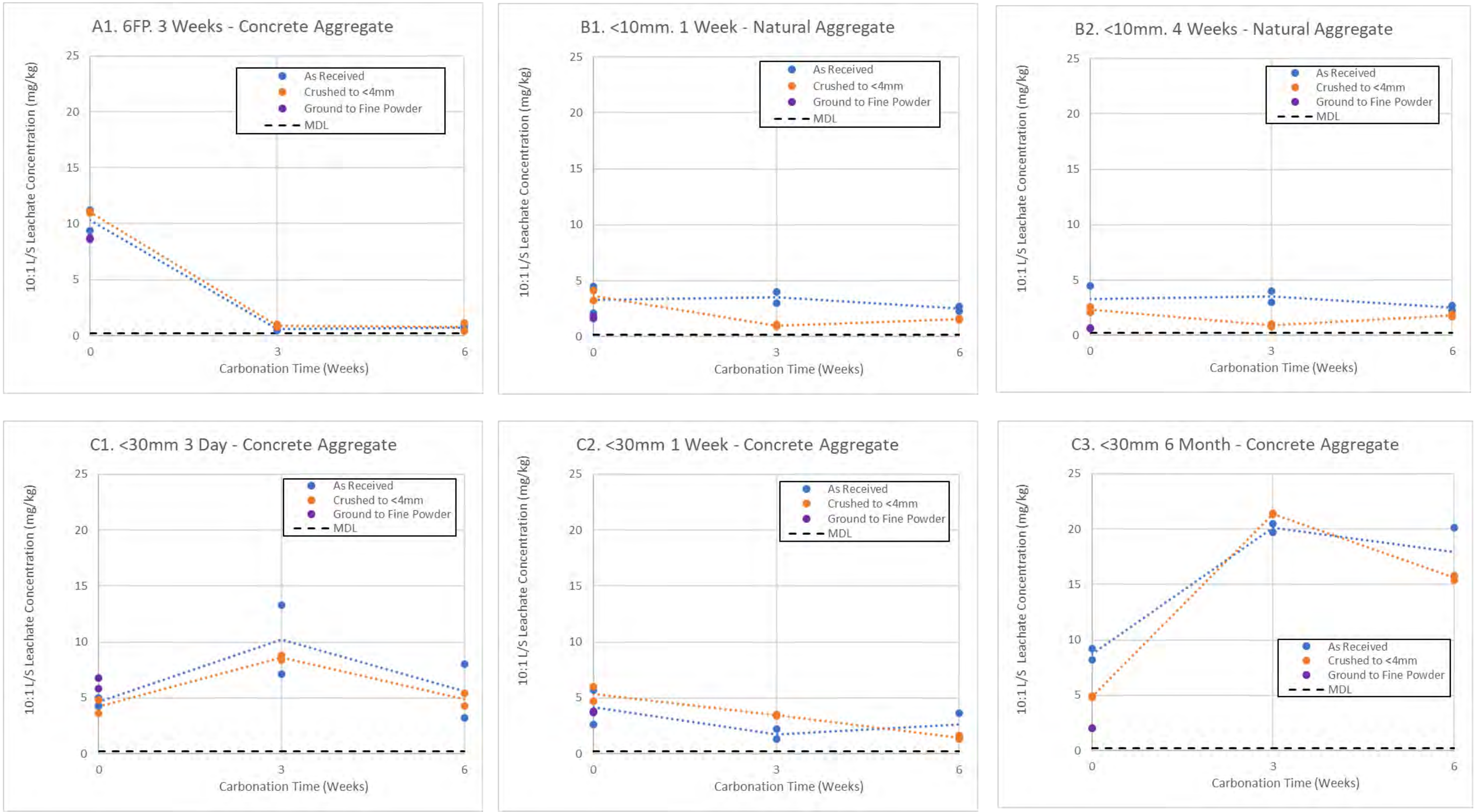
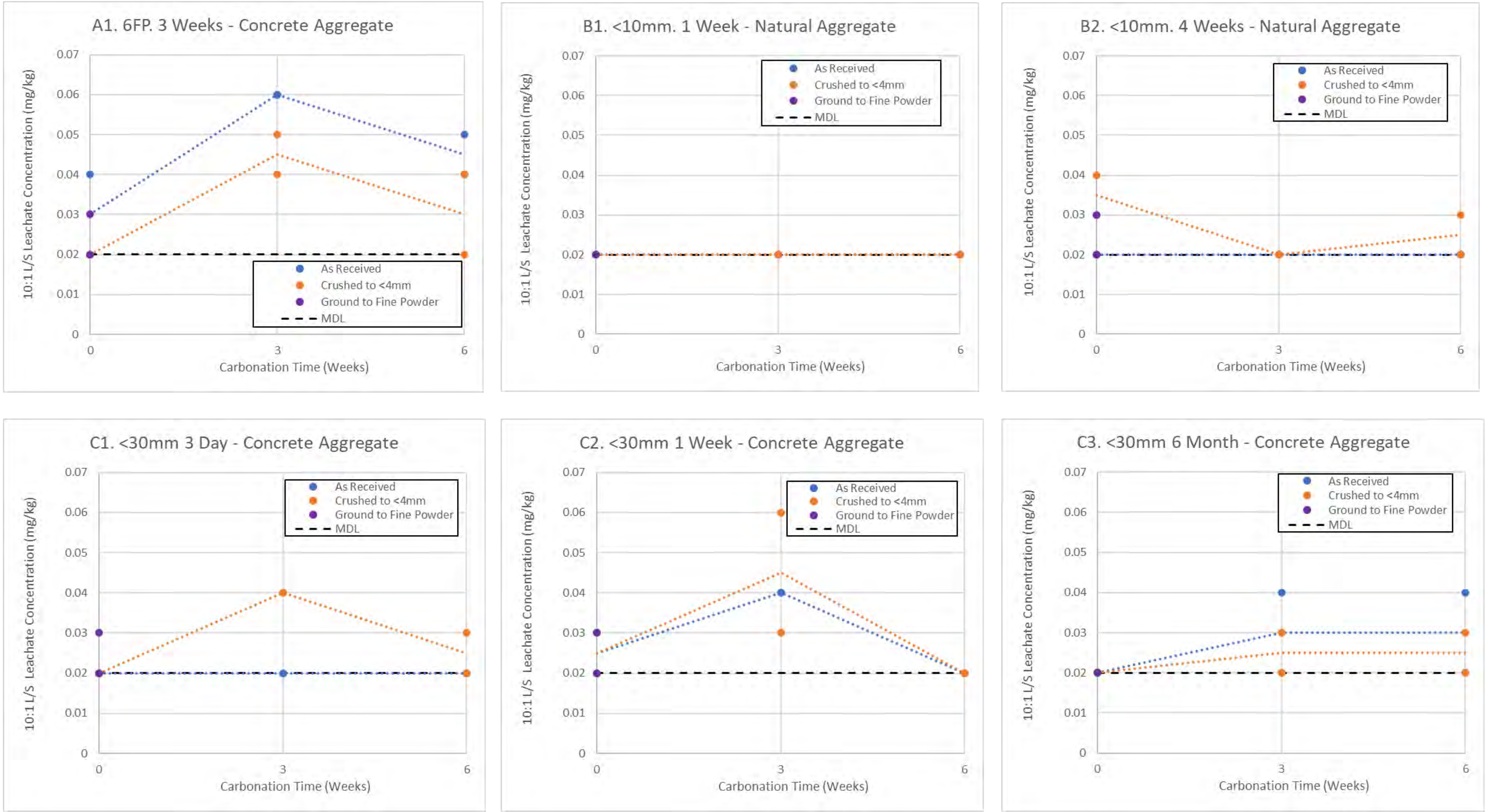


Figure IV12 – Leachate Aluminium Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type



A1. 6FP. 3 Weeks - Concrete Aggregate

B1. <10mm. 1 Week - Natural Aggregate

B2. <10mm. 4 Weeks - Natural Aggregate

C1. <30mm 3 Day - Concrete Aggregate

C2. <30mm 1 Week - Concrete Aggregate

C3. <30mm 6 Month - Concrete Aggregate

Figure IV13 – Leachate Antimony Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

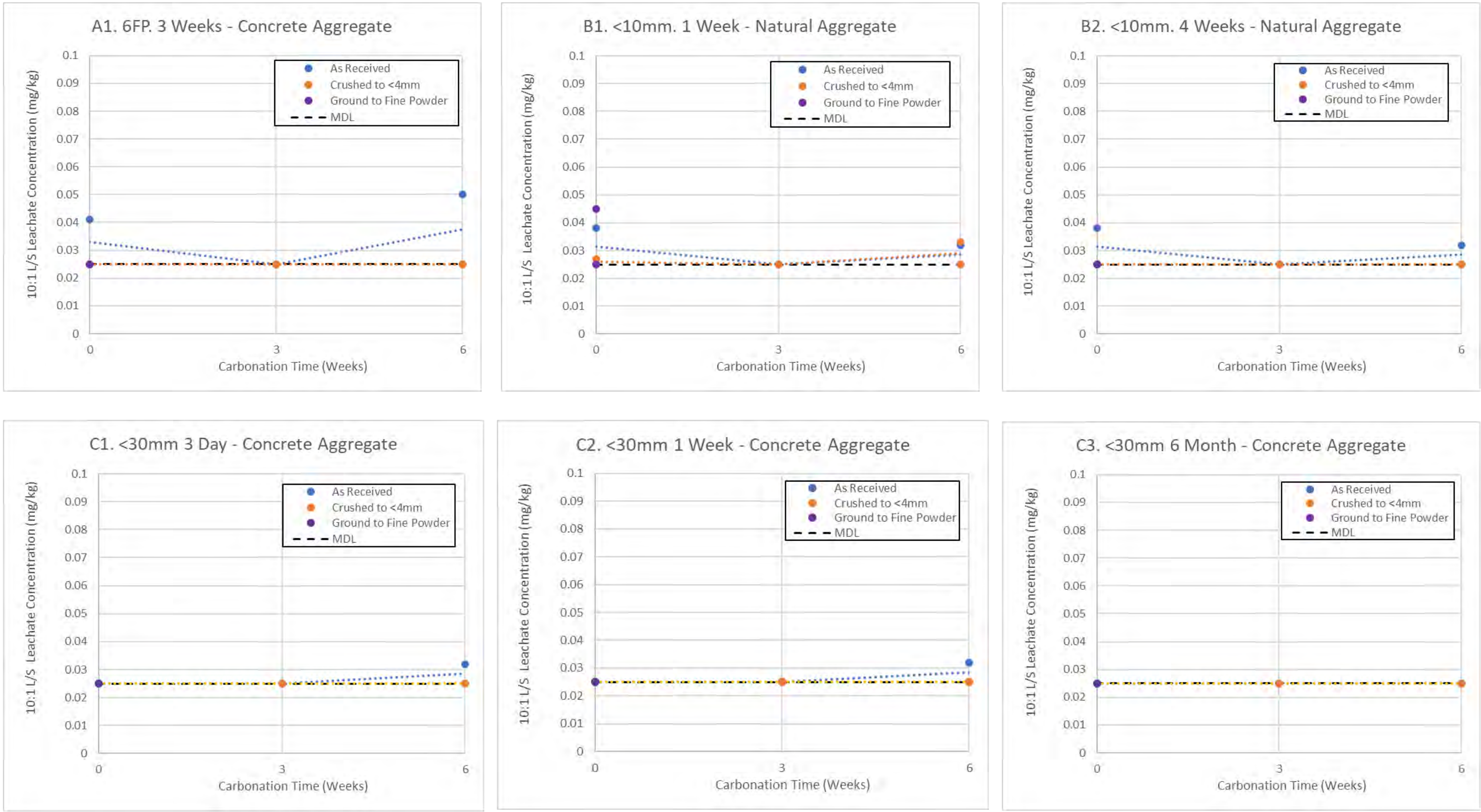


Figure IV14 – Leachate Arsenic Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

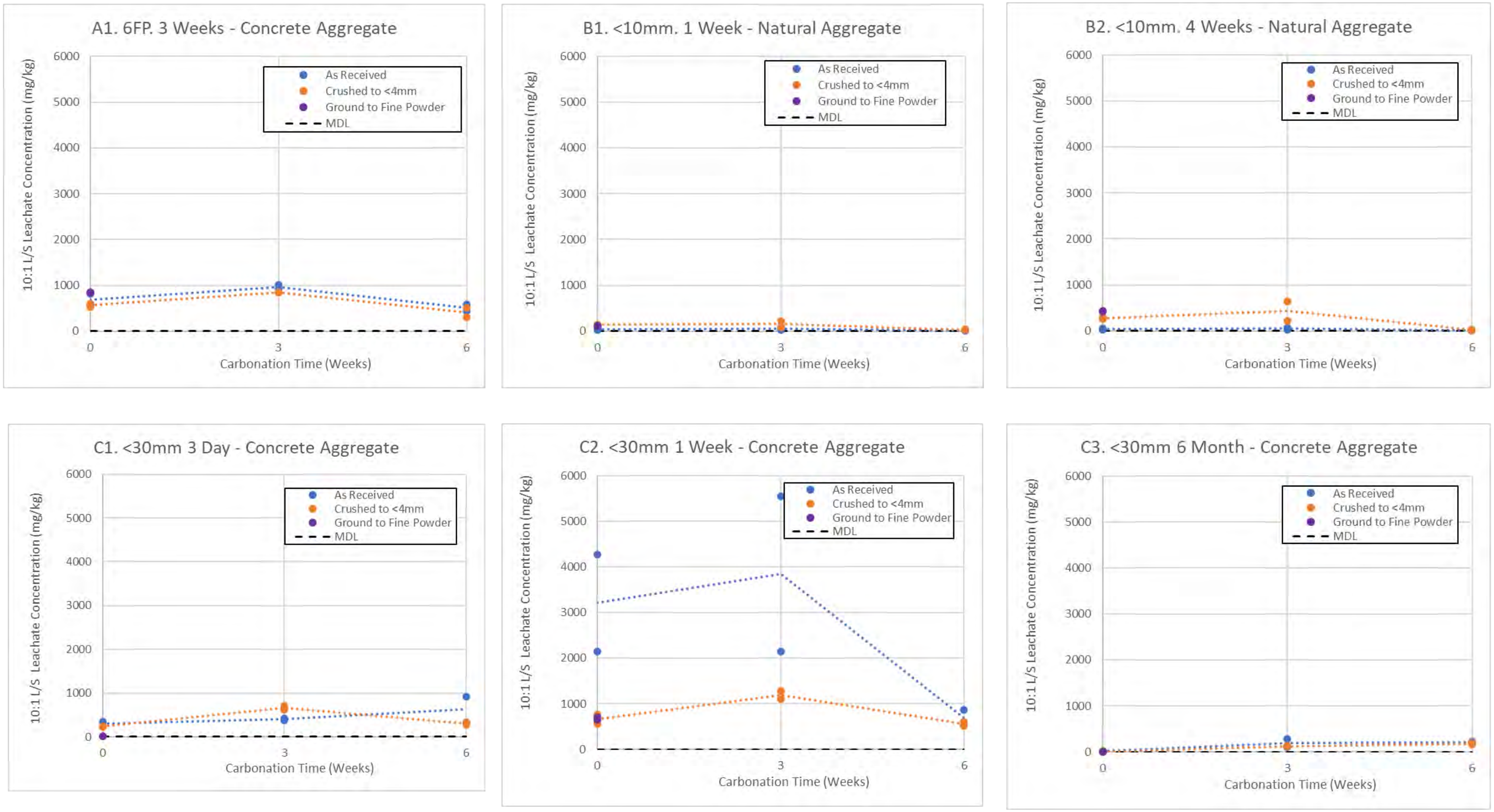


Figure IV15 – Leachate Sulphate Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

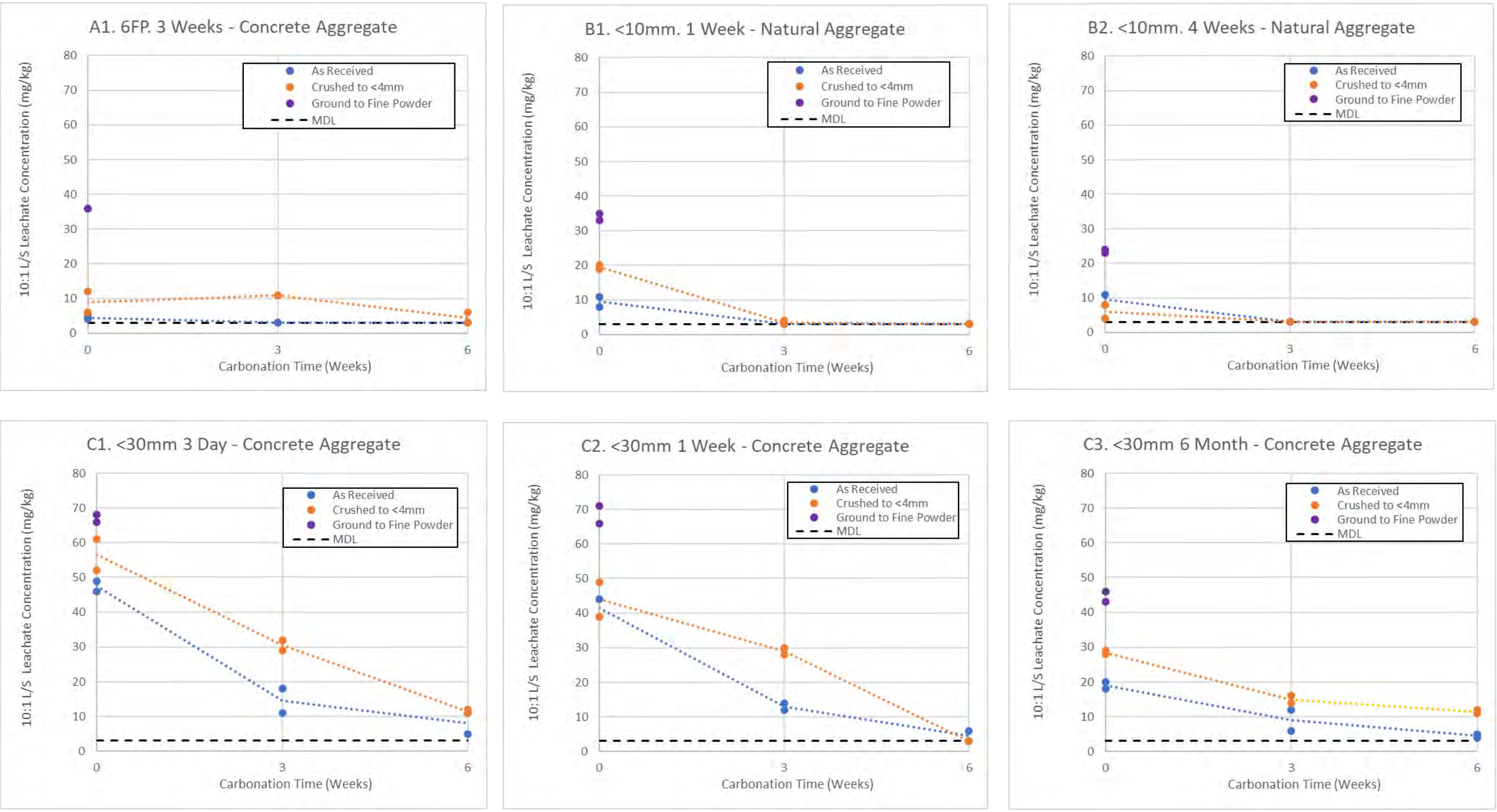
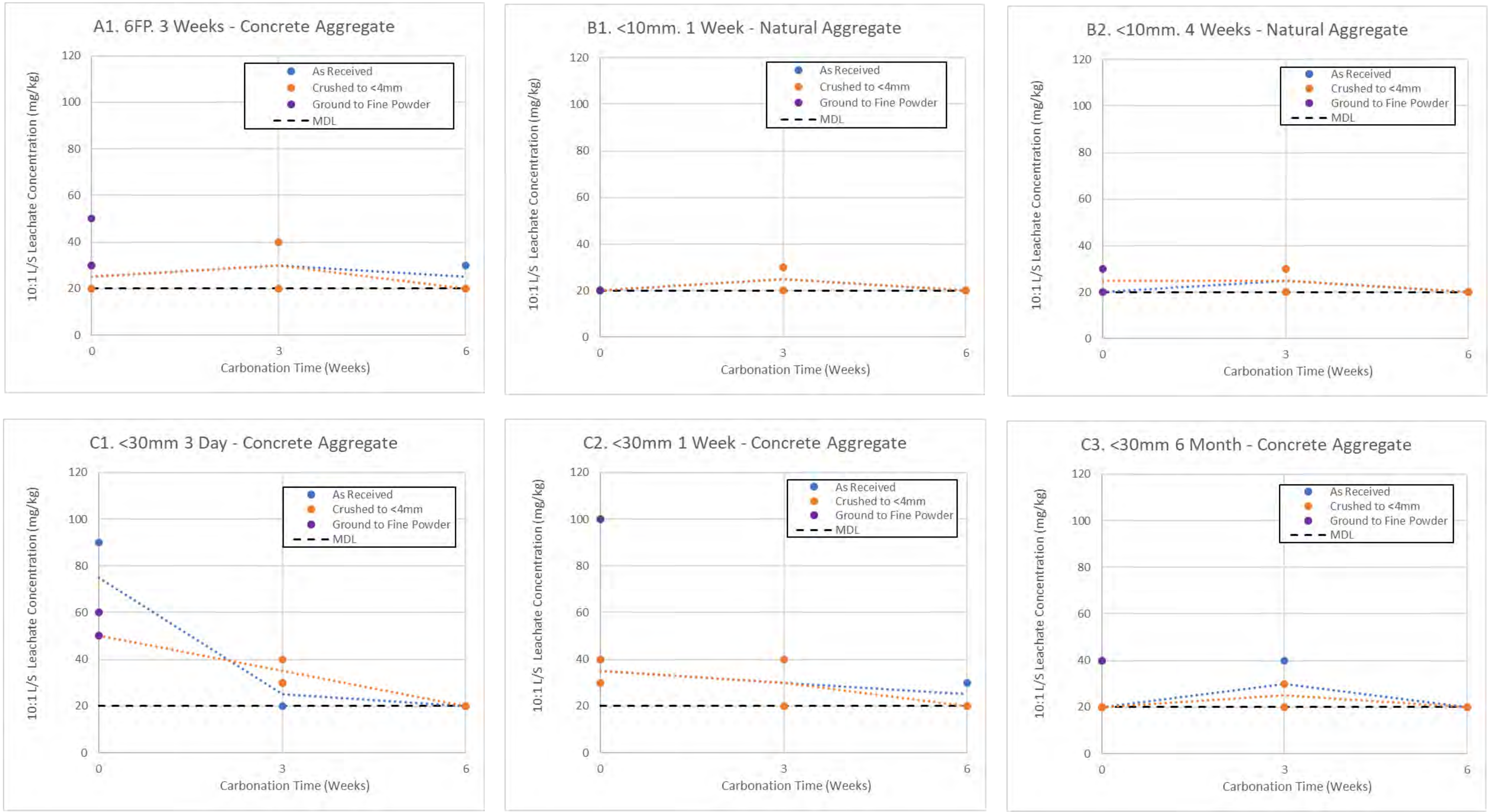


Figure IV16 – Leachate Chloride Variation with Pre-Leaching Sample Preparation Method and Carbonation Time
Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type



A1. 6FP. 3 Weeks - Concrete Aggregate

B1. <10mm. 1 Week - Natural Aggregate

B2. <10mm. 4 Weeks - Natural Aggregate

C1. <30mm 3 Day - Concrete Aggregate

C2. <30mm 1 Week - Concrete Aggregate

C3. <30mm 6 Month - Concrete Aggregate

Figure IV17 – Leachate Dissolved Organic Carbon Variation with Pre-Leaching Sample Preparation Method and Carbonation Time

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time – Aggregate Type

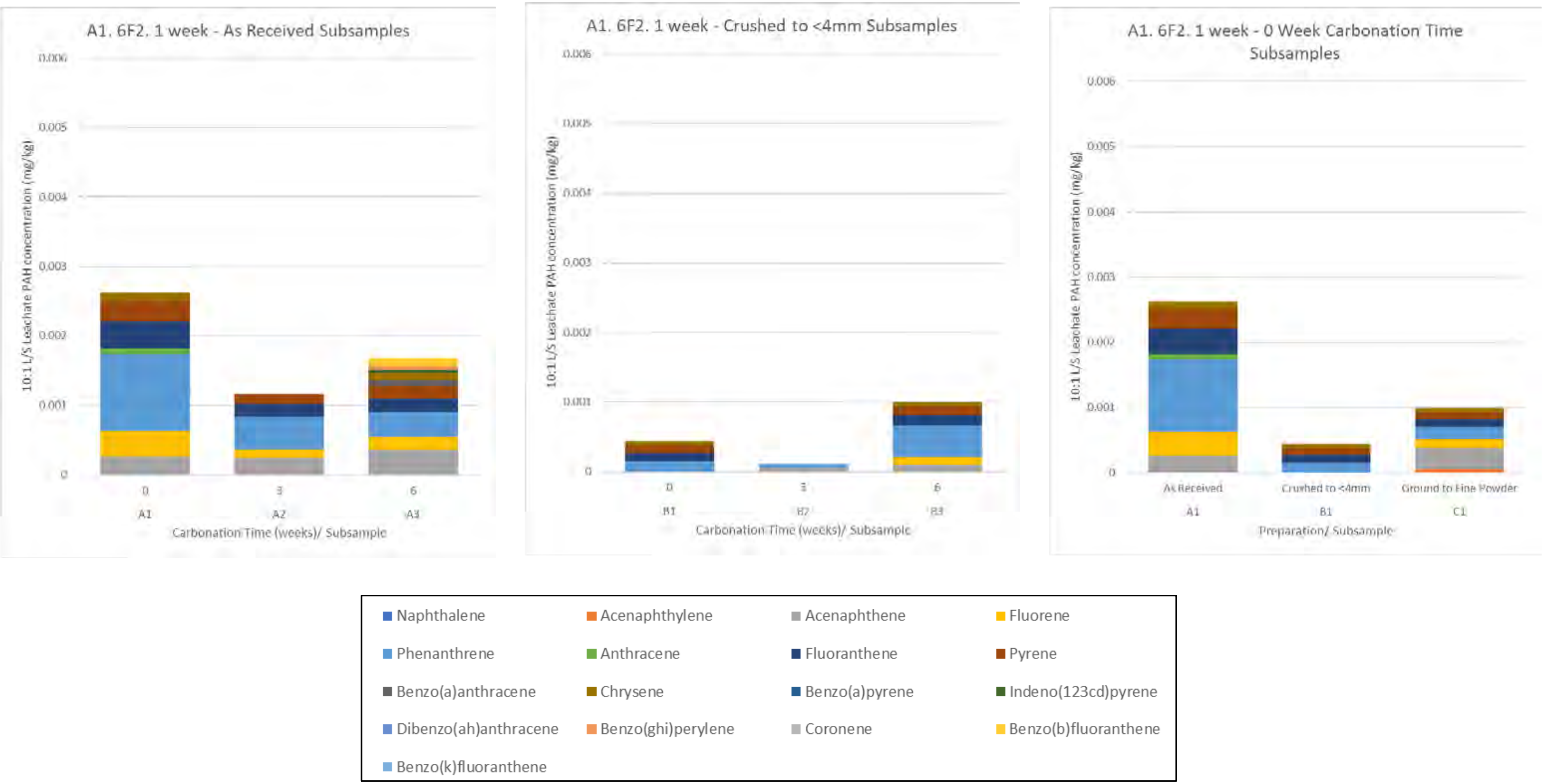


Figure IV18 – Detectable Leachate PAH Concentration Variation with Pre-Leaching Sample Preparation Method and Carbonation Time for Concrete Aggregate Sample A1

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time

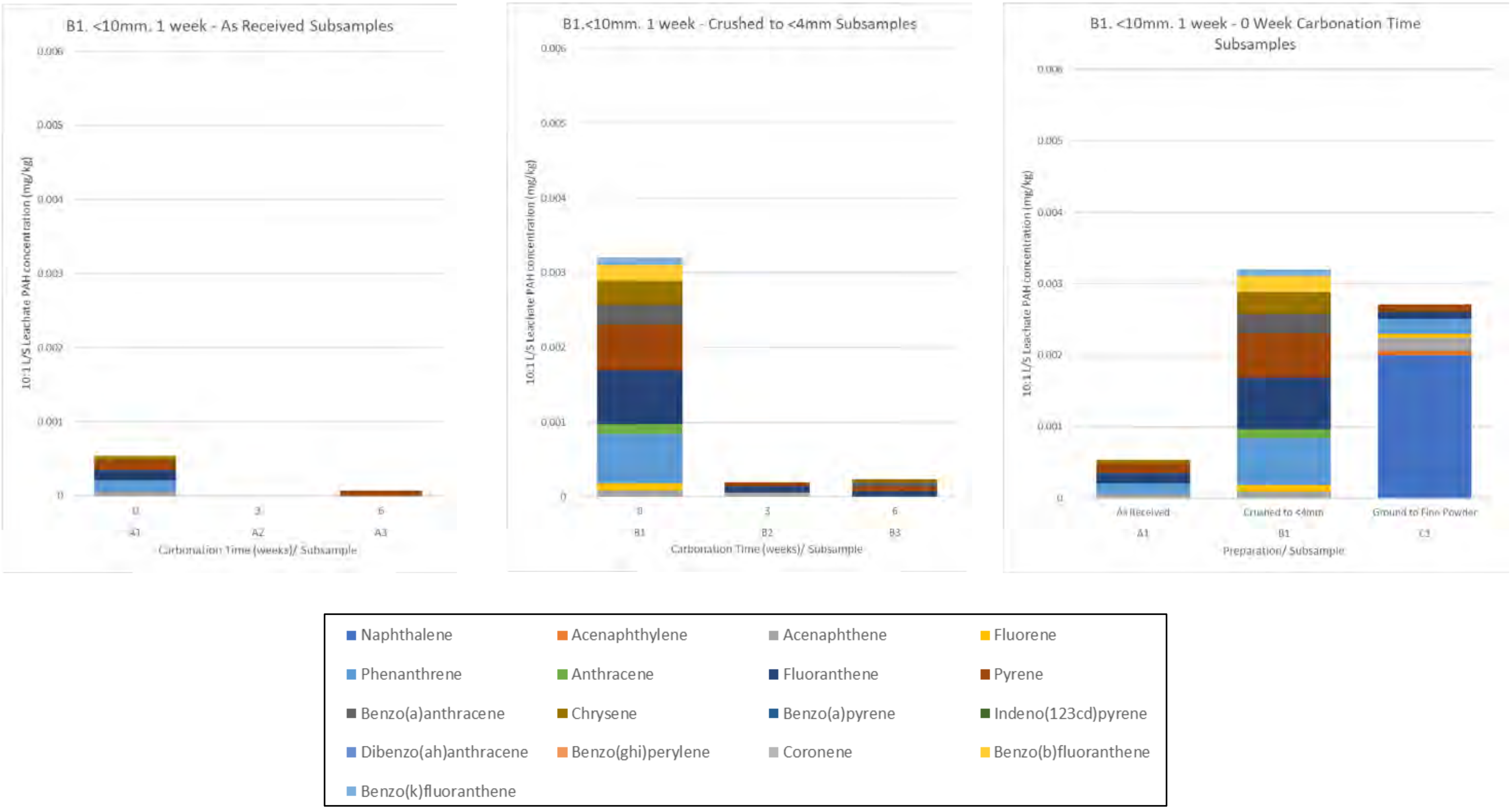


Figure IV19 – Detectable Leachate PAH Concentration Variation with Pre-Leaching Sample Preparation Method and Carbonation Time for Natural Aggregate Sample B1

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time

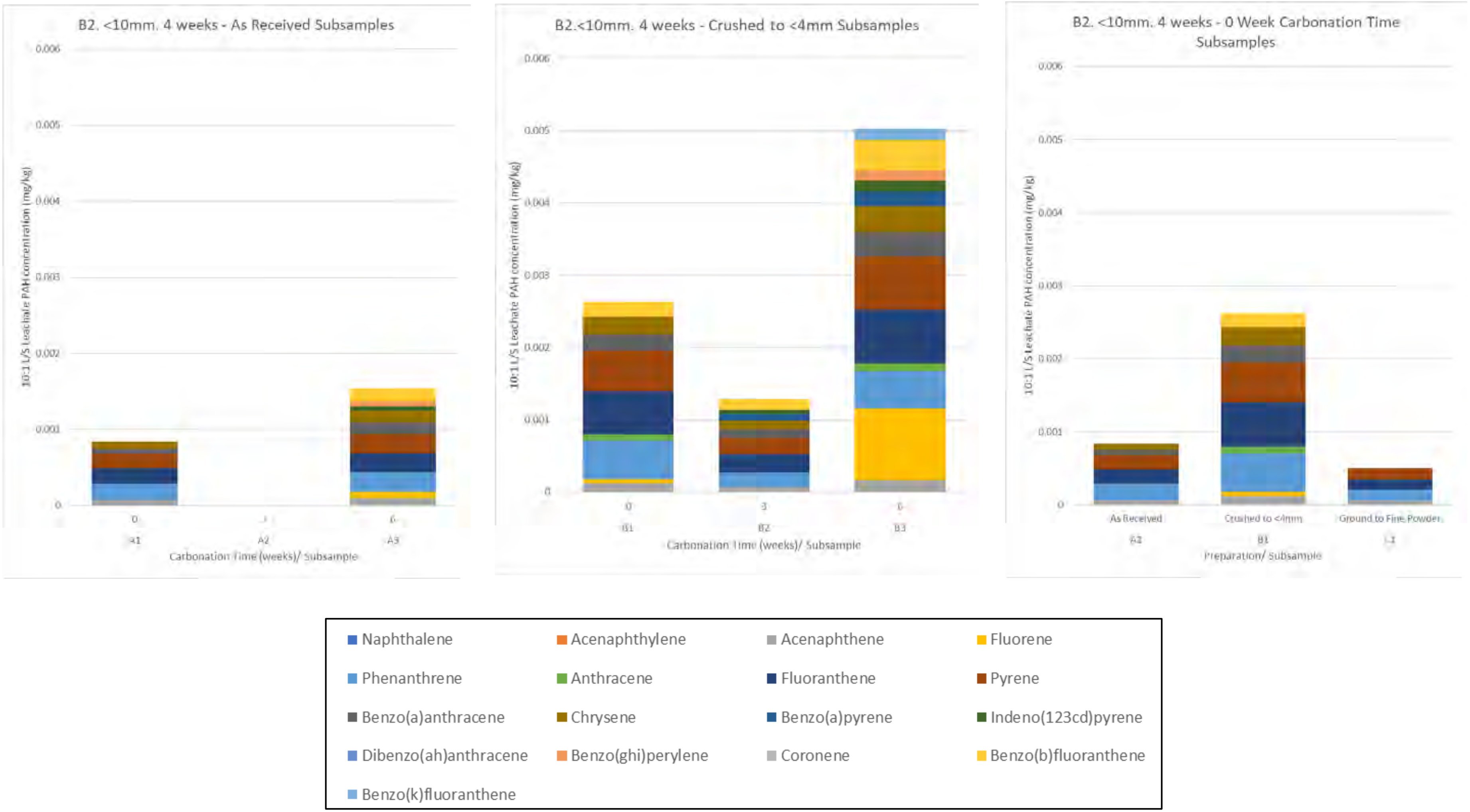


Figure IV20 – Detectable Leachate PAH Concentration Variation with Pre-Leaching Sample Preparation Method and Carbonation Time for Natural Aggregate Sample B2

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time

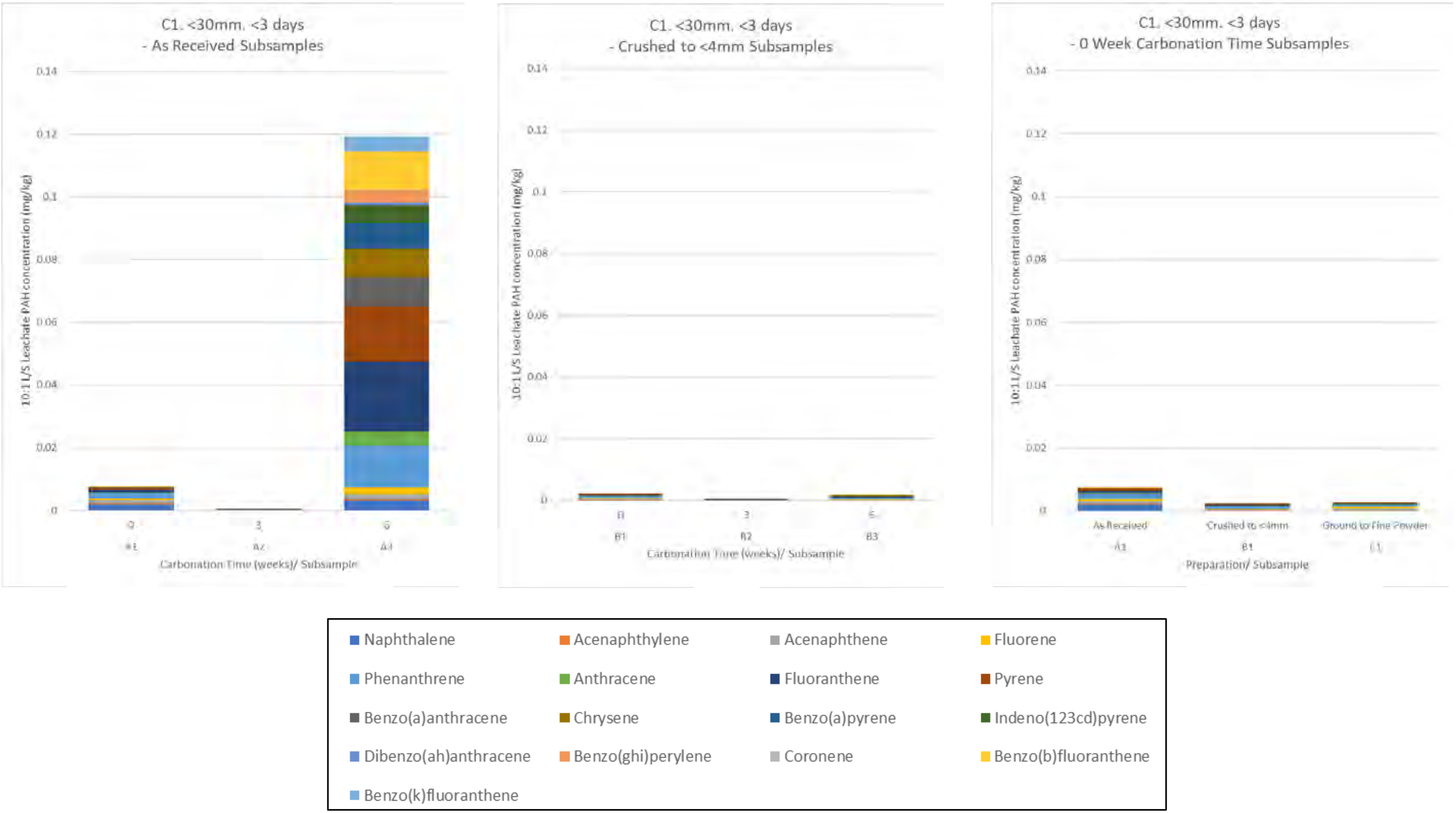


Figure IV21 – Detectable Leachate PAH Concentration Variation with Pre-Leaching Sample Preparation Method and Carbonation Time for Concrete Aggregate Sample C1

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time

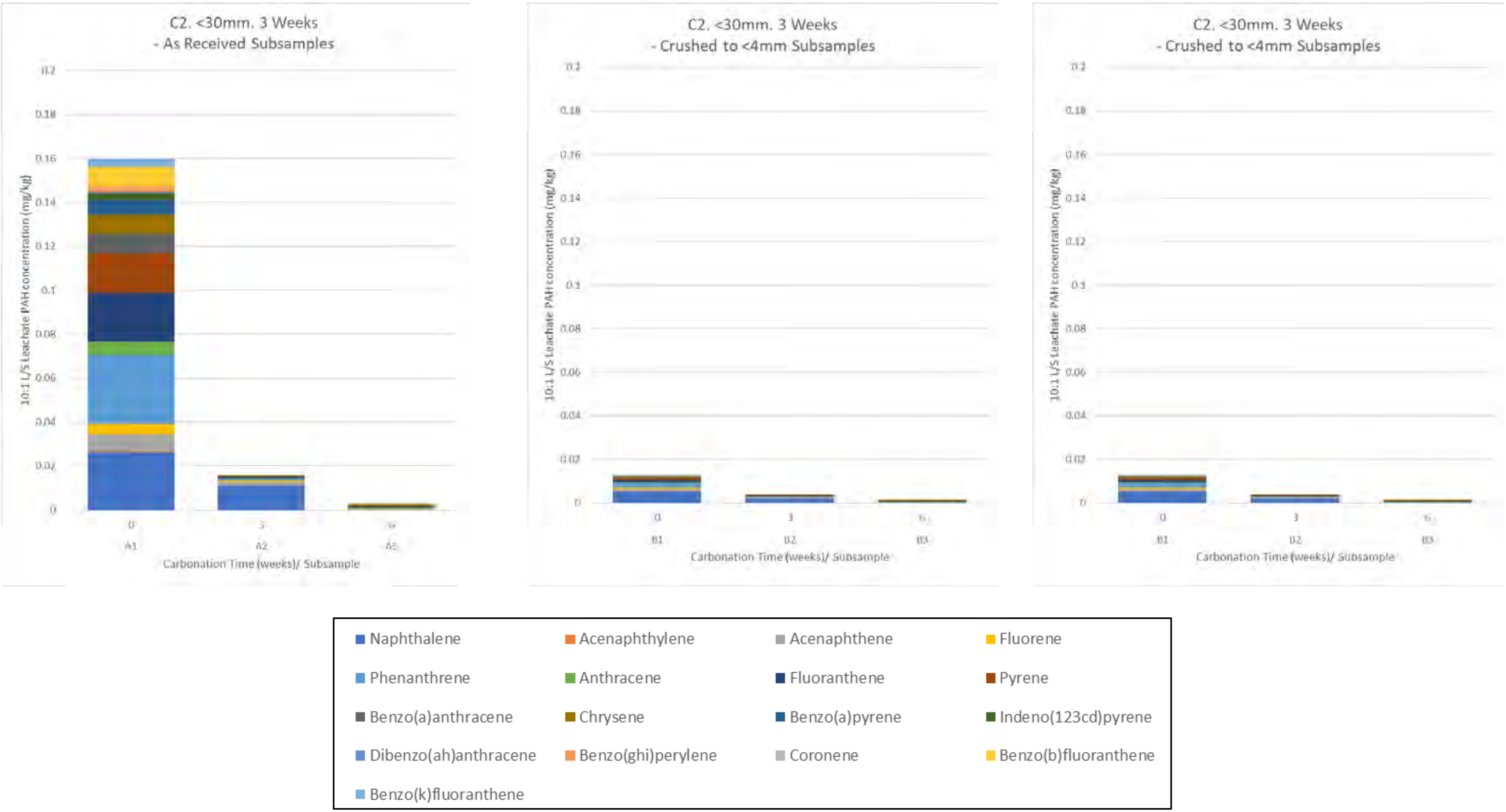


Figure IV22 – Detectable Leachate PAH Concentration Variation with Pre-Leaching Sample Preparation Method and Carbonation Time for Concrete Aggregate Sample C2

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time

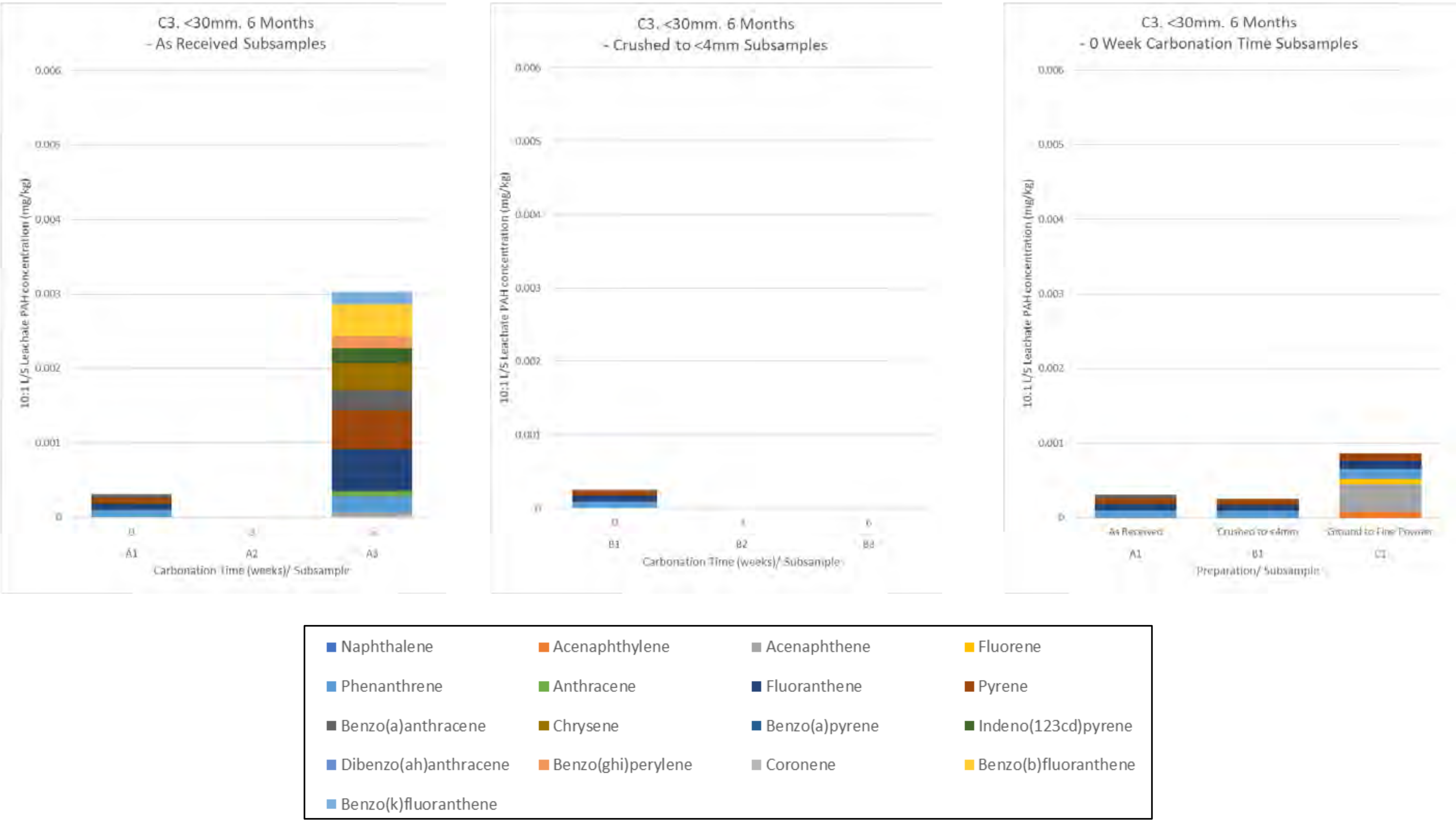


Figure IV23 – Detectable Leachate PAH Concentration Variation with Pre-Leaching Sample Preparation Method and Carbonation Time for Concrete Aggregate Sample C3

Graph titles state in order: Sample Number. Aggregate Grade. Stockpile Time

A P P E N D I X

V

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Dublin
D09 W8DT

UKAS TESTING 4225

Attention :	Gareth Barns
Date :	26th January, 2023
Your reference :	GCU0146045
Our reference :	Test Report 22/19389 Batch 1 Schedule A 22/19389 Batch 1 Schedule B
Location :	Confidential
Date samples received :	24th November, 2022
Status :	Final Report
Issue :	3

Ninety samples were received for analysis on 24th November, 2022 of which forty two were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc
Project Manager

Please include all sections of this report if it is reproduced

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-8	9-16	17-24	25-32	33-40	41-48							
Sample ID	A.1.6FP.3W	B.1.10.1WK	B.2.10.4WK	C.1.30.3DAY	C.2.30.1WK	C.3.30.6MONTH							
Depth													
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
Aluminium	4300	4080	3860	6270	7510	12300					<50	mg/kg	TM30/PM15
Antimony	<1	<1	<1	<1	<1	<1					<1	mg/kg	TM30/PM15
Arsenic #	8.0	10.9	8.2	7.6	8.6	5.3					<0.5	mg/kg	TM30/PM15
Barium #	66	32	40	51	54	45					<1	mg/kg	TM30/PM15
Cadmium #	0.5	0.9	0.5	0.4	0.4	<0.1					<0.1	mg/kg	TM30/PM15
Calcium	244000	196000	190000	233000	153000	97500					<500	mg/kg	TM30/PM15
Chromium #	24.1	29.2	28.8	27.3	35.5	48.4					<0.5	mg/kg	TM30/PM15
Copper #	13	10	14	20	17	35					<1	mg/kg	TM30/PM15
Lead #	23	11	10	9	12	9					<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM30/PM15
Molybdenum #	1.5	1.9	2.2	1.4	1.8	1.9					<0.1	mg/kg	TM30/PM15
Nickel #	15.6	14.5	15.4	16.1	19.2	24.8					<0.7	mg/kg	TM30/PM15
Potassium	964	510	478	859	1040	1170					<5	mg/kg	TM30/PM15
Selenium #	<1	<1	<1	<1	<1	<1					<1	mg/kg	TM30/PM15
Vanadium	17	15	15	24	27	34					<1	mg/kg	TM30/PM15
Zinc #	57	55	44	42	49	56					<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	0.33	<0.04					<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	0.18	<0.05					<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	0.17	<0.04					<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	0.04	0.12	1.39	<0.03					<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	0.32	<0.04					<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	0.04	0.14	1.25	<0.03					<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	0.04	0.13	1.01	<0.03					<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	<0.06	0.07	0.48	<0.06					<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	<0.02	0.06	0.49	<0.02					<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	<0.07	0.08	0.68	<0.07					<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	0.36	<0.04					<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	0.21	<0.04					<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04					<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	0.18	<0.04					<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04					<0.04	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64	<0.64	<0.64	7.05	<0.64					<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	0.06	0.49	<0.05					<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	0.02	0.19	<0.02					<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	93	99	97	88	92	93					<0	%	TM4/PM8
SVOC TICs	See Attached	ND	ND	See Attached	See Attached	See Attached						None	TM16/PM8

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-8	9-16	17-24	25-32	33-40	41-48							
Sample ID	A.1.6FP.3W	B.1.10.1WK	B.2.10.4WK	C.1.30.3DAY	C.2.30.1WK	C.3.30.6MONTH							
Depth													
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
TPH CWG													
Aliphatics													
>C5-C6 (HS_1D_AL)#	<0.1	<0.1	<0.1	0.2	<0.1	<0.1					<0.1	mg/kg	TM36/PM12
>C6-C8 (HS_1D_AL)#	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM36/PM12
>C8-C10 (HS_1D_AL)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM36/PM12
>C10-C12 (EH_CU_1D_AL)#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2					<0.2	mg/kg	TM5/PM8/PM16
>C12-C16 (EH_CU_1D_AL)#	11	<4	<4	19	<4	<4					<4	mg/kg	TM5/PM8/PM16
>C16-C21 (EH_CU_1D_AL)#	47	<7	<7	82	<7	<7					<7	mg/kg	TM5/PM8/PM16
>C21-C35 (EH_CU_1D_AL)#	195	<7	<7	226	<7	27					<7	mg/kg	TM5/PM8/PM16
>C35-C44 (EH_1D_AL)	41	<7	<7	19	<7	<7					<7	mg/kg	TM5/PM8/PM16
Total aliphatics C5-44 (EH+HS_1D_AL)	294	<26	<26	346	<26	27					<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Aromatics													
>C5-EC7 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM36/PM12
>EC7-EC8 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM36/PM12
>EC8-EC10 (HS_1D_AR)#	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR)#	<0.2^{SV}	<0.2	<0.2	<0.2	<0.2	<0.2					<0.2	mg/kg	TM5/PM8/PM16
>EC12-EC16 (EH_CU_1D_AR)#	<4^{SV}	<4	<4	<4	<4	<4					<4	mg/kg	TM5/PM8/PM16
>EC16-EC21 (EH_CU_1D_AR)#	<7^{SV}	<7	<7	<7	<7	<7					<7	mg/kg	TM5/PM8/PM16
>EC21-EC35 (EH_CU_1D_AR)#	156^{SV}	<7	<7	92	83	<7					<7	mg/kg	TM5/PM8/PM16
>EC35-EC44 (EH_1D_AR)	69^{SV}	<7	<7	32	24	<7					<7	mg/kg	TM5/PM8/PM16
Total aromatics C5-44 (EH+HS_1D_AR)	225^{SV}	<26	<26	124	107	<26					<26	mg/kg	TM5/TM36/PM8/PM12/PM16
Total aliphatics and aromatics(C5-44) (EH+HS_CU_1D_Total)	519^{SV}	<52	<52	470	107	<52					<52	mg/kg	TM5/TM36/PM8/PM12/PM16
MTBE#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM36/PM12
Benzene#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM36/PM12
Toluene#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM36/PM12
Ethylbenzene#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM36/PM12
m/p-Xylene#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM36/PM12
o-Xylene#	<0.005	<0.005	<0.005	0.011	<0.005	<0.005					<0.005	mg/kg	TM36/PM12
PCB 28#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
PCB 52#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
PCB 101#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
PCB 118#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
PCB 138#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
PCB 153#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
PCB 180#	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM17/PM8
Total 7 PCBs#	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035					<0.035	mg/kg	TM17/PM8
Resorcinol	<0.01	<0.01	<0.01	0.05	0.01	<0.01					<0.01	mg/kg	TM26/PM21B
Catechol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM26/PM21B
Phenol#	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM26/PM21B
m/p-cresol#	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					<0.02	mg/kg	TM26/PM21B
o-cresol#	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM26/PM21B

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All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-8	9-16	17-24	25-32	33-40	41-48							
Sample ID	A.1.6FP.3W	B.1.10.1WK	B.2.10.4WK	C.1.30.3DAY	C.2.30.1WK	C.3.30.6MONTH							
Depth													
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
Total cresols #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/kg	TM26/PM21B
Xylenols #	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06					<0.06	mg/kg	TM26/PM21B
1-naphthol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM26/PM21B
2,3,5-trimethyl phenol #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM26/PM21B
2-isopropylphenol #	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM26/PM21B
Total Speciated Phenols HPLC	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15					<0.15	mg/kg	TM26/PM21B
Natural Moisture Content	10.2	3.4	3.7	5.9	7.9	6.3					<0.1	%	PM4/PM0
Chloride #	31	31	21	42	56	24					<2	mg/kg	TM38/PM20
Fluoride	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3					<0.3	mg/kg	TM173/PM20
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3					<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	0.217	0.0426	0.158	0.0053	0.307	0.0027					<0.0015	g/l	TM38/PM20
Total Organic Carbon #	0.49	0.23	0.79	0.15	0.66	0.09					<0.02	%	TM21/PM24
pH #	11.5	9.23	9.30	12.3	11.7	12.5					<0.01	pH units	TM73/PM11

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All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	49	50	51	52	53	54	55	56	57	58	LOD/LOR	Units	Method No.
Sample ID	A.1.6FP.3W - Leachate C1	B.1.10.1WK - Leachate C1	B.2.10.4WK - Leachate C1	C.1.30.3DAY - Leachate C1	C.2.30.1WK - Leachate C1	C.3.30.6MONTH - Leachate C1	A.1.6FP.3W - Leachate A1 (i)	A.1.6FP.3W - Leachate A1 (ii)	B.1.10.1WK - Leachate A1 (i)	B.1.10.1WK - Leachate A1 (ii)			
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	8.6	1.6	0.6	5.8	3.8	2.0	11.2	9.4	4.5	2.1	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.03	<0.02	<0.02	0.03	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.041	<0.025	<0.025	0.038	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.29	0.04	0.08	3.66	0.40	2.76	0.22	0.20	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	1090	112	229	4200	1750	7430	580	733	105	98	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.822	0.019	0.017	0.185	0.803	0.114	0.151	0.131	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	0.14	0.09	0.10	0.06	0.15	0.02	<0.02	<0.02	<0.02	0.03	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	267	20	17	235	181	222	237	192	6	7	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.063	0.075	0.064	<0.015	0.038	<0.015	0.090	0.081	0.038	0.019	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	0.002	<0.001	<0.001	0.003	<0.001	<0.001	-	<0.001^{SV}	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	0.00005	0.00006	<0.00005	0.00018	0.00017	0.00008	<0.00005	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00033	0.00018	0.00007	0.00078	0.00107	0.00036	0.00026	-	0.00006^{SV}	-	<0.00005	mg/kg	TM4/PM30
Fluorene	0.00013	0.00006	<0.00005	0.00027	0.00045	0.00008	0.00037	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00019	0.00021	0.00014	0.00069	0.00140	0.00013	0.00111	-	0.00015^{SV}	-	<0.00005	mg/kg	TM4/PM30
Anthracene	<0.00005	<0.00005	<0.00005	0.00009	0.00015	<0.00005	0.00008	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00012	0.00010	0.00014	0.00031	0.00054	0.00011	0.00039	-	0.00014^{SV}	-	<0.00005	mg/kg	TM4/PM30
Pyrene	0.00011	0.00010	0.00015	0.00025	0.00043	0.00010	0.00029	-	0.00013^{SV}	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	<0.00005	<0.00005	<0.00005	<0.00005	0.00007	<0.00005	<0.00005	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Chrysene	0.00006	<0.00005	<0.00005	0.00007	0.00013	<0.00005	0.00012	-	0.00006^{SV}	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	-	<0.00008^{SV}	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-	<0.00005^{SV}	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	<0.001^{SV}	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	<0.00273	<0.00273	<0.00273	<0.00273	0.00741	<0.00273	<0.00273	-	<0.00273^{SV}	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	76	76	74	78	80	73	75	-	69^{SV}	-	<0	%	TM4/PM30
SVOC TICs	ND	ND	ND	ND	ND	ND	ND	-	ND	-		None	TM16/PM30

Please see attached notes for all abbreviations and acronyms

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All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential	**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub	
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	49	50	51	52	53	54	55	56	57	58	LOD/LOR	Units	Method No.
Sample ID	A.1.6FP.3W - Leachate C1	B.1.10.1WK - Leachate C1	B.2.10.4WK - Leachate C1	C.1.30.3DAY - Leachate C1	C.2.30.1WK - Leachate C1	C.3.30.6MONTH - Leachate C1	A.1.6FP.3W - Leachate A1 (i)	A.1.6FP.3W - Leachate A1 (ii)	B.1.10.1WK - Leachate A1 (i)	B.1.10.1WK - Leachate A1 (ii)			
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	<0.001	<0.001^{SV}	<0.001	<0.001	<0.001	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	<0.007	<0.007^{SV}	<0.007	<0.007	<0.007	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	49	50	51	52	53	54	55	56	57	58			
Sample ID	A.1.6FP.3W - Leachate C1	B.1.10.1WK - Leachate C1	B.2.10.4WK - Leachate C1	C.1.30.3DAY - Leachate C1	C.2.30.1WK - Leachate C1	C.3.30.6MONTH - Leachate C1	A.1.6FP.3W - Leachate A1 (i)	A.1.6FP.3W - Leachate A1 (ii)	B.1.10.1WK - Leachate A1 (i)	B.1.10.1WK - Leachate A1 (ii)			
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	<1	<1	<1	<1	<1	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	5	4	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	844	121	422	17	648	<5	563	818	53	33	<5	mg/kg	TM38/PM0
Chloride	36	35	24	66	71	43	5	4	11	8	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	5	2	3	6	10	4	3	<2	<2	<2	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06	0.49	<0.06	0.07	<0.06	<0.06	<0.06	<0.06	mg/kg	TM38/PM0
pH	11.7	9.58	9.32	12.4	11.9	12.6	11.3	11.2	9.93	9.35	<0.01	pH units	TM73/PM0

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Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	59	60	61	62	63	64	65	66	67	68			
Sample ID	B.2.10.4WK - Leachate A1 (i)	B.2.10.4WK - Leachate A1 (ii)	C.1.30.3DAY - Leachate A1 (i)	C.1.30.3DAY - Leachate A1 (ii)	C.2.30.1WK - Leachate A1 (i)	C.2.30.1WK - Leachate A1 (ii)	C.3.30.6MONTH - Leachate A1 (i)	C.3.30.6MONTH - Leachate A1 (ii)	A.1.6FP.3W - Leachate B1 (i)	A.1.6FP.3W - Leachate B1 (ii)			
Preparation	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	3.4	2.1	5.0	4.3	5.7	2.6	8.2	9.2	11.0	11.1	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	<0.02	0.03	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	<0.03	<0.03	1.04	1.04	0.27	0.42	1.38	1.12	0.25	0.21	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	83	85	2190	2210	1490	2670	3630	3220	756	619	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	<0.015	<0.015	0.306	0.285	0.399	0.465	0.104	0.111	0.435	0.259	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	0.17	0.11	0.08	0.10	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02	<0.02	0.06	0.06	0.06	0.06	<0.02	<0.02	0.04	0.02	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	0.02	0.03	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	4	7	260	259	121	132	76	63	258	301	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.030	0.019	<0.015	0.016	0.134	0.112	<0.015	<0.015	0.073	0.087	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	0.002	-	0.026	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	<0.00005	-	0.00026	-	0.00056	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00007	-	0.00095	-	0.00776	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Fluorene	<0.00005	-	0.00054	-	0.00481	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00022	-	0.00173	-	0.03142	-	0.00010	-	0.00015	-	<0.00005	mg/kg	TM4/PM30
Anthracene	<0.00005	-	0.00023	-	0.00603	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00020	-	0.00078	-	0.02241	-	0.00008	-	0.00012	-	<0.00005	mg/kg	TM4/PM30
Pyrene	0.00019	-	0.00064	-	0.01791	-	0.00008	-	0.00011	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	0.00007	-	0.00013	-	0.00872	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Chrysene	0.00009	-	0.00017	-	0.00883	-	<0.00005	-	0.00006	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	<0.00008	-	0.00016	-	0.01251	-	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005	-	0.00645	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	<0.00005	-	<0.00005	-	0.00336	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005	-	0.00044	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	<0.00005	-	<0.00005	-	0.00246	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	<0.00273	-	0.00759	-	0.15967	-	<0.00273	-	<0.00273	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	<0.00008	-	0.00012	-	0.00901	-	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	-	<0.00008	-	0.00350	-	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	80	-	78	-	74	-	76	-	78	-	<0	%	TM4/PM30
SVOC TICs	ND	-	ND	-	ND	-	ND	-	ND	-		None	TM16/PM30

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Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	59	60	61	62	63	64	65	66	67	68	LOD/LOR	Units	Method No.
Sample ID	B.2.10.4WK - Leachate A1 (i)	B.2.10.4WK - Leachate A1 (ii)	C.1.30.3DAY - Leachate A1 (i)	C.1.30.3DAY - Leachate A1 (ii)	C.2.30.1WK - Leachate A1 (i)	C.2.30.1WK - Leachate A1 (ii)	C.3.30.6MONTH - Leachate A1 (i)	C.3.30.6MONTH - Leachate A1 (ii)	A.1.6FP.3W - Leachate B1 (i)	A.1.6FP.3W - Leachate B1 (ii)			
Preparation	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05^{SV}	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1^{SV}	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1^{SV}	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1^{SV}	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1^{SV}	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1^{SV}	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1^{SV}	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

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Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	59	60	61	62	63	64	65	66	67	68			
Sample ID	B.2.10.4WK - Leachate A1 (i)	B.2.10.4WK - Leachate A1 (ii)	C.1.30.3DAY - Leachate A1 (i)	C.1.30.3DAY - Leachate A1 (ii)	C.2.30.1WK - Leachate A1 (i)	C.2.30.1WK - Leachate A1 (ii)	C.3.30.6MONTH - Leachate A1 (i)	C.3.30.6MONTH - Leachate A1 (ii)	A.1.6FP.3W - Leachate B1 (i)	A.1.6FP.3W - Leachate B1 (ii)			
Preparation	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-	<1	-	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	42	45	237	354	2150	4270	21	27	601	530	<5	mg/kg	TM38/PM0
Chloride	<3	<3	46	49	39	44	20	18	12	6	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	<2	<2	6	9	4	3	<2	<2	<2	3	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	0.20	0.22	0.24	0.26	<0.06	<0.06	0.39	0.11	<0.06	mg/kg	TM38/PM0
pH	9.30	9.27	12.1	12.1	11.4	11.4	12.3	12.3	9.85	11.4	<0.01	pH units	TM73/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	69	70	71	72	73	74	75	76	77	78			
Sample ID	B.1.10.1WK - Leachate B1 (i)	B.1.10.1WK - Leachate B1 (ii)	B.2.10.4WK - Leachate B1 (i)	B.2.10.4WK - Leachate B1 (ii)	C.1.30.3DAY - Leachate B1 (i)	C.1.30.3DAY - Leachate B1 (ii)	C.2.30.1WK - Leachate B1 (i)	C.2.30.1WK - Leachate B1 (ii)	C.3.30.6MONTH - Leachate B1 (i)	C.3.30.6MONTH - Leachate B1 (ii)			
Preparation	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	3.2	4.1	2.1	2.6	4.8	3.6	6.0	4.7	4.8	4.9	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	<0.02	<0.02	0.04	0.03	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	0.027	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.028	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.04	0.05	0.05	0.06	1.11	1.13	0.39	0.42	1.74	1.74	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	158	201	182	193	2430	2720	1500	1640	4970	4910	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.024	0.030	<0.015	<0.015	0.261	0.288	0.465	0.476	0.093	0.096	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.08	0.08	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	0.06	0.07	0.04	0.03	0.05	0.06	0.06	0.07	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	13	15	12	13	184	199	133	139	88	85	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.115	0.116	0.058	0.065	<0.015	<0.015	0.051	0.040	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	0.07	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	<0.001^{SV}	-	<0.001	-	0.005^{SV}	-	<0.001	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	<0.00005	-	<0.00005^{SV}	-	0.00013	-	0.00012^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00009	-	0.00012^{SV}	-	0.00039	-	0.00129^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Fluorene	0.00009	-	0.00006^{SV}	-	0.00018	-	0.00060^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00066	-	0.00053^{SV}	-	0.00063	-	0.00231^{SV}	-	0.00009	-	<0.00005	mg/kg	TM4/PM30
Anthracene	0.00013	-	0.00009^{SV}	-	0.00008	-	0.00033^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00072	-	0.00060^{SV}	-	0.00037	-	0.00103^{SV}	-	0.00008	-	<0.00005	mg/kg	TM4/PM30
Pyrene	0.00062	-	0.00055^{SV}	-	0.00031	-	0.00081^{SV}	-	0.00008	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	0.00026	-	0.00023^{SV}	-	0.00008	-	0.00028^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Chrysene	0.00032	-	0.00025^{SV}	-	0.00011	-	0.00031^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	0.00031	-	0.00028^{SV}	-	<0.00008	-	0.00040^{SV}	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	0.00020^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	<0.00005^{SV}	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001^{SV}	-	<0.001	-	<0.001^{SV}	-	<0.001	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	0.00320	-	<0.00273^{SV}	-	<0.00273	-	0.01268^{SV}	-	<0.00273	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	0.00022	-	0.00020	-	<0.00008	-	0.00029	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	0.00009	-	<0.00008	-	<0.00008	-	0.00011	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	76	-	66^{SV}	-	71	-	67^{SV}	-	72	-	<0	%	TM4/PM30
SVOC TICs	ND	-	ND	-	ND	-	ND	-	ND	-		None	TM16/PM30

Please see attached notes for all abbreviations and acronyms

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential	**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub	
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	69	70	71	72	73	74	75	76	77	78	LOD/LOR	Units	Method No.
Sample ID	B.1.10.1WK - Leachate B1 (i)	B.1.10.1WK - Leachate B1 (ii)	B.2.10.4WK - Leachate B1 (i)	B.2.10.4WK - Leachate B1 (ii)	C.1.30.3DAY - Leachate B1 (i)	C.1.30.3DAY - Leachate B1 (ii)	C.2.30.1WK - Leachate B1 (i)	C.2.30.1WK - Leachate B1 (ii)	C.3.30.6MONTH - Leachate B1 (i)	C.3.30.6MONTH - Leachate B1 (ii)			
Preparation	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	69	70	71	72	73	74	75	76	77	78	LOD/LOR	Units	Method No.
Sample ID	B.1.10.1WK - Leachate B1 (i)	B.1.10.1WK - Leachate B1 (ii)	B.2.10.4WK - Leachate B1 (i)	B.2.10.4WK - Leachate B1 (ii)	C.1.30.3DAY - Leachate B1 (i)	C.1.30.3DAY - Leachate B1 (ii)	C.2.30.1WK - Leachate B1 (i)	C.2.30.1WK - Leachate B1 (ii)	C.3.30.6MONTH - Leachate B1 (i)	C.3.30.6MONTH - Leachate B1 (ii)			
Preparation	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-	<1	-	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	127	147	302	262	228	246	559	769	16	7	<5	mg/kg	TM38/PM0
Chloride	20	19	8	4	52	61	39	49	29	28	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	<2	<2	2	3	5	5	3	4	2	2	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06	0.21	0.27	0.42	0.34	<0.06	<0.06	<0.06	mg/kg	TM38/PM0
pH	10.0	10.3	9.54	11.5	12.1	12.2	11.8	11.9	12.4	12.4	<0.01	pH units	TM73/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	79	80	81	82	83	84							
Sample ID	A.1.6FP.3W - Leachate C1 (ii)	B.1.10.1WK - Leachate C1 (ii)	B.2.10.4WK - Leachate C1 (ii)	C.1.30.3DAY - Leachate C1 (ii)	C.2.30.1WK - Leachate C1 (ii)	C.3.30.6MONTH - Leachate C1 (ii)							
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C							
COC No / misc													
Containers	T	T	T	T	T	T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
Dissolved Aluminium (A10)	8.7	1.8	0.7	6.8	3.7	2.0					<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.02	<0.02	0.03	<0.02	0.03	0.02					<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	0.045	<0.025	<0.025	<0.025	<0.025					<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.30	0.03	0.08	3.58	0.40	2.80					<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	1160	103	226	4200	1770	7970					<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.822	0.017	0.019	0.194	0.779	0.108					<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07	0.07	<0.07					<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05					<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	0.14	0.10	0.10	0.06	0.14	<0.02					<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	272	18	19	255	178	225					<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.055	0.062	0.054	<0.015	0.036	<0.015					<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03					<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	-	-	-	-	-	-					<0.001	mg/kg	TM4/PM30
Acenaphthylene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Acenaphthene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Fluorene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Phenanthrene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Anthracene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Fluoranthene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Pyrene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Chrysene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	-	-	-	-	-	-					<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	-	-	-	-	-	-					<0.00005	mg/kg	TM4/PM30
Coronene	-	-	-	-	-	-					<0.001	mg/kg	TM4/PM30
PAH 17 Total	-	-	-	-	-	-					<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	-	-	-	-	-	-					<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	-	-	-	-	-	-					<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	-	-	-	-	-	-					<0	%	TM4/PM30
SVOC TICs	-	-	-	-	-	-						None	TM16/PM30

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	79	80	81	82	83	84					LOD/LOR	Units	Method No.
Sample ID	A.1.6FP.3W - Leachate C1 (ii)	B.1.10.1WK - Leachate C1 (ii)	B.2.10.4WK - Leachate C1 (ii)	C.1.30.3DAY - Leachate C1 (ii)	C.2.30.1WK - Leachate C1 (ii)	C.3.30.6MONTH - Leachate C1 (ii)							
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C							
COC No / misc													
Containers	T	T	T	T	T	T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1							
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
TPH CWG													
Aliphatics													
>C5-C6	-	-	-	-	-	-					<0.1	mg/kg	TM36/PM69
>C6-C8	-	-	-	-	-	-					<0.1	mg/kg	TM36/PM69
>C8-C10	-	-	-	-	-	-					<0.1	mg/kg	TM36/PM69
>C10-C12	-	-	-	-	-	-					<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	-	-	-	-	-	-					<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	-	-	-	-	-	-					<0.1	mg/kg	TM36/PM69
>EC7-EC8	-	-	-	-	-	-					<0.1	mg/kg	TM36/PM69
>EC8-EC10	-	-	-	-	-	-					<0.1	mg/kg	TM36/PM69
>EC10-EC12	-	-	-	-	-	-					<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	-	-	-	-	-	-					<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	-	-	-	-	-	-					<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	-	-	-	-	-	-					<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	-	-	-	-	-	-					<0.05	mg/kg	TM36/PM69
Benzene	-	-	-	-	-	-					<0.05	mg/kg	TM36/PM69
Toluene	-	-	-	-	-	-					<0.05	mg/kg	TM36/PM69
Ethylbenzene	-	-	-	-	-	-					<0.05	mg/kg	TM36/PM69
m/p-Xylene	-	-	-	-	-	-					<0.05	mg/kg	TM36/PM69
o-Xylene	-	-	-	-	-	-					<0.05	mg/kg	TM36/PM69
PCB 28	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
PCB 52	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
PCB 101	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
PCB 118	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
PCB 138	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
PCB 153	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
PCB 180	-	-	-	-	-	-					<0.001	mg/kg	TM17/PM30
Total 7 PCBs	-	-	-	-	-	-					<0.007	mg/kg	TM17/PM30
Resorcinol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0
Catechol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0
Phenol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0
m/p-cresol	-	-	-	-	-	-					<0.2	mg/kg	TM26/PM0
o-cresol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	79	80	81	82	83	84							
Sample ID	A.1.6FP.3W - Leachate C1 (ii)	B.1.10.1WK - Leachate C1 (ii)	B.2.10.4WK - Leachate C1 (ii)	C.1.30.3DAY - Leachate C1 (ii)	C.2.30.1WK - Leachate C1 (ii)	C.3.30.6MONTH - Leachate C1 (ii)							
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C							
COC No / misc													
Containers	T	T	T	T	T	T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1					LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
Total cresols	-	-	-	-	-	-					<0.3	mg/kg	TM26/PM0
Xylenols	-	-	-	-	-	-					<0.6	mg/kg	TM26/PM0
1-naphthol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0
2-isopropylphenol	-	-	-	-	-	-					<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	-	-	-	-	-	-					<1	mg/kg	TM26/PM0
Fluoride	<3	3	4	<3	<3	<3					<3	mg/kg	TM173/PM0
Sulphate as SO4	849	116	436	18	712	10					<5	mg/kg	TM38/PM0
Chloride	36	33	23	68	66	46					<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	3	<2	<2	5	10	4					<2	mg/l	TM60/PM0
Hexavalent Chromium	0.79	<0.06	<0.06	<0.06	0.64	<0.06					<0.06	mg/kg	TM38/PM0
pH	11.7	9.57	9.35	12.4	12.0	12.6					<0.01	pH units	TM73/PM0

Client Name:	Geosyntec Consulting	**SVOC Report :**	**Solid**
Reference:	GCU0146045		
Location:	Confidential		
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-8	9-16	17-24	25-32	33-40	41-48					LOD/LOR	Units	Method No.
Sample ID	A.1.6FP.3W	B.1.10.1WK	B.2.10.4WK	C.1.30.3DAY	C.2.30.1WK	C.3.30.6MONTH							
Depth													
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T							
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022							
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate							
Batch Number	1	1	1	1	1	1							
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022							
SVOC MS													
Phenols													
2-Chlorophenol$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2-Methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2-Nitrophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2,4-Dichlorophenol$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2,4-Dimethylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2,4,5-Trichlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Chloro-3-methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Nitrophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Pentachlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Phenol$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
PAHs													
2-Chloronaphthalene$^{\#}$	<0.01^{+}	<0.01^{+}	<0.01^{+}	<0.01^{+}	<0.01^{+}	<0.01^{+}					<0.01	mg/kg	TM16/PM8
2-Methylnaphthalene$^{\#}$	0.01	<0.01	<0.01	0.07	0.06	<0.01					<0.01	mg/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	5.9	<0.1	<0.1	0.6	0.3	1.0					<0.1	mg/kg	TM16/PM8
Butylbenzyl phthalate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM16/PM8
Di-n-butyl phthalate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM16/PM8
Di-n-Octyl phthalate	0.2	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM16/PM8
Diethyl phthalate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1					<0.1	mg/kg	TM16/PM8
Dimethyl phthalate$^{\#}$	<0.1^{+}	<0.1^{+}	<0.1^{+}	<0.1^{+}	<0.1^{+}	<0.1^{+}					<0.1	mg/kg	TM16/PM8
Other SVOCs													
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
1,2,4-Trichlorobenzene$^{\#}$	<0.01^{+}	<0.01^{+}	<0.01^{+}	<0.01^{+}	<0.01^{+}	<0.01^{+}					<0.01	mg/kg	TM16/PM8
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2,4-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
2,6-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
3-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Bromophenylphenylether$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Chloroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Chlorophenylphenylether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
4-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Azobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Bis(2-chloroethyl)ether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Carbazole	<0.01	<0.01	<0.01	0.06	0.05	<0.01					<0.01	mg/kg	TM16/PM8
Dibenzofuran$^{\#}$	<0.01	<0.01	<0.01	0.08	0.06	<0.01					<0.01	mg/kg	TM16/PM8
Hexachlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Hexachlorobutadiene$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Hexachloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Isophorone$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
N-nitrosodi-n-propylamine$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Nitrobenzene$^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					<0.01	mg/kg	TM16/PM8
Surrogate Recovery 2-Fluorobiphenyl	132^{SV}	129	126	143^{SV}	139^{SV}	135^{SV}					<0	%	TM16/PM8
Surrogate Recovery p-Terphenyl-d14	130^{SV}	121	109	135^{SV}	121	122					<0	%	TM16/PM8

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

SVOC Report : **CEN 10:1 1 Batch**

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	49	50	51	52	53	54	55	57	59	61			
Sample ID	A.1.6FP.3W - Leachate C1	B.1.10.1WK - Leachate C1	B.2.10.4WK - Leachate C1	C.1.30.3DAY - Leachate C1	C.2.30.1WK - Leachate C1	C.3.30.6MONTH - Leachate C1	A.1.6FP.3W - Leachate A1 (i)	B.1.10.1WK - Leachate A1 (i)	B.2.10.4WK - Leachate A1 (i)	C.1.30.3DAY - Leachate A1 (i)			
Preparation	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	Fine Powder - D&C	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
SVOC MS													
Phenols													
2-Chlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
2-Methylphenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
2-Nitrophenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
2,4-Dichlorophenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
2,4-Dimethylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
2,4,5-Trichlorophenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
4-Chloro-3-methylphenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
4-Methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
4-Nitrophenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM16/PM30
Pentachlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
PAHs													
2-Chloronaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM16/PM30
Butylbenzyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Di-n-butyl phthalate	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM16/PM30
Di-n-Octyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Diethyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Dimethyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Other SVOCs													
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
2-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
2,4-Dinitrotoluene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
2,6-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
3-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
4-Bromophenylphenylether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
4-Chloroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
4-Chlorophenylphenylether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
4-Nitroaniline	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
Azobenzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
Bis(2-chloroethoxy)methane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
Bis(2-chloroethyl)ether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Carbazole	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
Dibenzofuran	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
Hexachlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Hexachlorobutadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Hexachloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Isophorone	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
N-nitrosodi-n-propylamine	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM16/PM30
Nitrobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	97	108	119	108	109	100	100	107	90	126	<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	108	120	129	123	119	118	127	116	97	147^{SV}	<0	%	TM16/PM30

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	Geosyntec Consulting	**SVOC Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential		
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	63	65	67	69	71	73	75	77			LOD/LOR	Units	Method No.
Sample ID	C.2.30.1WK - Leachate A1 (i)	C.3.30.6MONTH - Leachate A1 (i)	A.1.6FP.3W - Leachate B1 (i)	B.1.10.1WK - Leachate B1 (i)	B.2.10.4WK - Leachate B1 (i)	C.1.30.3DAY - Leachate B1 (i)	C.2.30.1WK - Leachate B1 (i)	C.3.30.6MONTH - Leachate B1 (i)					
Preparation	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm					
COC No / misc													
Containers	T	T	T	T	T	T	T	T					
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022					
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate					
Batch Number	1	1	1	1	1	1	1	1					
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022					
SVOC MS													
Phenols													
2-Chlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
2-Methylphenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
2-Nitrophenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
2,4-Dichlorophenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
2,4-Dimethylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
2,4,5-Trichlorophenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
2,4,6-Trichlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
4-Chloro-3-methylphenol	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
4-Methylphenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
4-Nitrophenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			<0.1	mg/kg	TM16/PM30
Pentachlorophenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
PAHs													
2-Chloronaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
2-Methylnaphthalene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05			<0.05	mg/kg	TM16/PM30
Butylbenzyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Di-n-butyl phthalate	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015			<0.015	mg/kg	TM16/PM30
Di-n-Octyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Diethyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Dimethyl phthalate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Other SVOCs													
1,2-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
1,2,4-Trichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
1,3-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
1,4-Dichlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
2-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
2,4-Dinitrotoluene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
2,6-Dinitrotoluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
3-Nitroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
4-Bromophenylphenylether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
4-Chloroaniline	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
4-Chlorophenylphenylether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
4-Nitroaniline	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
Azobenzene	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
Bis(2-chloroethoxy)methane	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
Bis(2-chloroethyl)ether	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Carbazole	0.013	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
Dibenzofuran	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
Hexachlorobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Hexachlorobutadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Hexachlorocyclopentadiene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Hexachloroethane	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Isophorone	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
N-nitrosodi-n-propylamine	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005	mg/kg	TM16/PM30
Nitrobenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	mg/kg	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	90	113	90	96	120	111	97	80			<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	98	126	99	106	124	122	114	88			<0	%	TM16/PM30

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Job number:	22/19389	**Method:**	**SVOC**
Sample number:	3	**Matrix:**	**Solid**
Sample identity:	A.1.6FP.3W		
Sample depth:			
Sample Type:	Aggregate		
Units:	mg/kg		

Note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

CAS No.	Tentative Compound Identification	Retention Time (minutes)	% Match	Concentration
100-51-6	Benzyl Alcohol	5.073	97	0.6
95-51-2	o-Chloroaniline	6.011	95	0.2

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All solid results are expressed on a dry weight basis unless stated otherwise.

Job number: 22/19389 **Method:** **SVOC**
Sample number: 27 **Matrix:** **Solid**
Sample identity: C.1.30.3DAY
Sample depth:
Sample Type: Aggregate
Units: mg/kg

Note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

CAS No.	Tentative Compound Identification	Retention Time (minutes)	% Match	Concentration
629-50-5	Tridecane	7.604	94	0.4
629-59-4	Tetradecane	8.247	97	0.5
544-76-3	Hexadecane	9.382 - 11.254	93,94,98	3.1
31295-56-4	Dodecane, 2,6,11-trimethyl-	9.948	94	0.8
630-01-3	Hexacosane	10.366 - 11.672	91,94	1.8
629-92-5	Nonadecane	10.824	97	1.1
112-95-8	Eicosane	12.102 - 13.002	95,96,97	1.4

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All solid results are expressed on a dry weight basis unless stated otherwise.

Job number:	22/19389	**Method:**	**SVOC**
Sample number:	35	**Matrix:**	**Solid**
Sample identity:	C.2.30.1WK		
Sample depth:			
Sample Type:	Aggregate		
Units:	mg/kg		

Note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

CAS No.	Tentative Compound Identification	Retention Time (minutes)	% Match	Concentration
544-76-3	Hexadecane	13.002	91	0.1

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Element Materials Technology

Job number:	22/19389	**Method:**	**SVOC**
Sample number:	43	**Matrix:**	**Solid**
Sample identity:	C.3.30.6MONTH		
Sample depth:			
Sample Type:	Aggregate		
Units:	mg/kg		

Note: Only samples with TICs (if requested) are reported. If TICs were requested but no compounds found they are not reported.

CAS No.	Tentative Compound Identification	Retention Time (minutes)	% Match	Concentration
96-76-4	Phenol, 2,4-bis(1,1-dimethylethyl)-	8.781	93	0.1

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 22/19389						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

EMT Job No.: 22/19389

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM16/PM30/PM69	please refer to PM16/PM30 and PM69 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Preparation of Soil and Marine Sediment Samples for Total Organic Carbon.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21B	As Received samples are extracted in Methanol: Water (60:40) by reciprocal shaker.			AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21B	As Received samples are extracted in Methanol: Water (60:40) by reciprocal shaker.	Yes		AR	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM17	Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM69	One part soil is mixed with 10 parts water in a vial leaving no headspace. The mixture is shaken and then left to leach for 24 hours before VOC analysis.			AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.			AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	Yes
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998)	PM0	No preparation is required.			AR	Yes
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998)	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.			AR	Yes
NONE	No Method Code	PM17	Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.			AR	

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Geosyntec Consulting
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D09 W8DT

Attention : Gareth Barns

Date : 19th January, 2023

Your reference : GCU0146045

Our reference : Test Report 22/19389 Batch 1 Schedule C 22/19389 Batch 1 Schedule D 22/19389 Ba

Location : Confidential

Date samples received : 24th November, 2022

Status : Final report

Issue : 2

Ninety samples were received for analysis on 24th November, 2022 of which twenty four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc
Project Manager

Please include all sections of this report if it is reproduced

Client Name:	Geosyntec Consulting
Reference:	GCU0146045
Location:	Confidential
Contact:	Gareth Barns
EMT Job No:	22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	85	86	87	88	89	90	91	92	93	94			
Sample ID	A.1.6FP.3W - Leachate A2 (i)	A.1.6FP.3W - Leachate A2 (ii)	B.1.10.1WK - Leachate A2 (i)	B.1.10.1WK - Leachate A2 (ii)	B.2.10.4WK - Leachate A2 (i)	B.2.10.4WK - Leachate A2 (ii)	C.1.30.3DAY - Leachate A2 (i)	C.1.30.3DAY - Leachate A2 (ii)	C.2.30.1WK - Leachate A2 (i)	C.2.30.1WK - Leachate A2 (ii)			
Depth	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	0.7	0.5	4.0	3.0	2.2	1.8	7.1	13.3	1.3	2.2	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.06	0.06	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	0.04	0.04	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025	0.030	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.18	0.10	<0.03	<0.03	<0.03	0.04	0.31	0.18	0.32	0.11	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	429	490	74	89	93	86	2240	981	2550	1140	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.138	0.179	<0.015	<0.015	<0.015	<0.015	0.134	0.124	0.167	0.233	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	0.13	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02	0.03	<0.02	<0.02	0.04	0.03	<0.02	<0.02	0.03	0.03	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	131	153	6	10	9	12	133	108	93	89	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.193	0.227	0.030	0.066	0.044	0.028	0.144	0.092	0.175	0.222	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	0.10	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	0.011	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00024	-	<0.00005	-	<0.00005	-	0.00010	-	0.00168	-	<0.00005	mg/kg	TM4/PM30
Fluorene	0.00012	-	<0.00005	-	<0.00005	-	<0.00005	-	0.00056	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00047	-	<0.00005	-	<0.00005	-	0.00013	-	0.00114	-	<0.00005	mg/kg	TM4/PM30
Anthracene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	0.00013	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00019	-	<0.00005	-	<0.00005	-	0.00008	-	0.00041	-	<0.00005	mg/kg	TM4/PM30
Pyrene	0.00014	-	<0.00005	-	<0.00005	-	0.00007	-	0.00033	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	0.00012	-	<0.00005	mg/kg	TM4/PM30
Chrysene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	0.00011	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	-	0.00017	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	0.00008	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	0.00006	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	<0.00273	-	<0.00273	-	<0.00273	-	<0.00273	-	0.01579	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	-	0.00012	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	67^{SV}	-	67^{SV}	-	67^{SV}	-	66^{SV}	-	67^{SV}	-	<0	%	TM4/PM30

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	85	86	87	88	89	90	91	92	93	94	LOD/LOR	Units	Method No.
Sample ID	A.1.6FP.3W - Leachate A2 (i)	A.1.6FP.3W - Leachate A2 (ii)	B.1.10.1WK - Leachate A2 (i)	B.1.10.1WK - Leachate A2 (ii)	B.2.10.4WK - Leachate A2 (i)	B.2.10.4WK - Leachate A2 (ii)	C.1.30.3DAY - Leachate A2 (i)	C.1.30.3DAY - Leachate A2 (ii)	C.2.30.1WK - Leachate A2 (i)	C.2.30.1WK - Leachate A2 (ii)			
Depth	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	85	86	87	88	89	90	91	92	93	94			
Sample ID	A.1.6FP.3W - Leachate A2 (i)	A.1.6FP.3W - Leachate A2 (ii)	B.1.10.1WK - Leachate A2 (i)	B.1.10.1WK - Leachate A2 (ii)	B.2.10.4WK - Leachate A2 (i)	B.2.10.4WK - Leachate A2 (ii)	C.1.30.3DAY - Leachate A2 (i)	C.1.30.3DAY - Leachate A2 (ii)	C.2.30.1WK - Leachate A2 (i)	C.2.30.1WK - Leachate A2 (ii)			
Depth	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-	<1	-	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	917	1010	22	76	72	36	4430	384	5540	2140	<5	mg/kg	TM38/PM0
Chloride	<3	<3	<3	<3	<3	<3	11	18	14	12	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	4	<2	3	<2	3	<2	3	2	4	<2	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM38/PM0
pH	10.3	10.1	9.64	9.23	9.33	9.31	11.4	11.7	10.4	10.6	<0.01	pH units	TM73/PM0

Client Name:	Geosyntec Consulting
Reference:	GCU0146045
Location:	Confidential
Contact:	Gareth Barns
EMT Job No:	22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	95	96	97	98	99	100	101	102	103	104			
Sample ID	C.3.30.6MONTH - Leachate A2 (i)	C.3.30.6MONTH - Leachate A2 (ii)	A.1.6FP.3W - Leachate B2 (i)	A.1.6FP.3W - Leachate B2 (ii)	B.1.10.1WK - Leachate B2 (i)	B.1.10.1WK - Leachate B2 (ii)	B.2.10.4WK - Leachate B2 (i)	B.2.10.4WK - Leachate B2 (ii)	C.1.30.3DAY - Leachate B2 (i)	C.1.30.3DAY - Leachate B2 (ii)			
Depth	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	19.7	20.5	0.8	1.0	1.1	0.9	0.8	1.0	8.8	8.4	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	<0.02	0.04	0.04	0.05	<0.02	<0.02	<0.02	<0.02	0.04	0.04	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.13	0.08	0.11	0.10	0.04	0.04	0.11	0.07	0.12	0.11	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	839	527	517	539	106	105	309	152	683	650	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.189	0.096	0.461	0.472	<0.015	<0.015	<0.015	<0.015	0.202	0.252	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02	<0.02	0.05	0.05	0.05	0.05	0.07	0.07	0.03	0.03	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	92	74	144	152	12	12	14	13	129	155	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.055	0.055	0.218	0.228	0.057	0.052	0.017	0.026	0.200	0.209	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	<0.00005	-	0.00005	-	0.00006	-	0.00007	-	0.00009	-	<0.00005	mg/kg	TM4/PM30
Fluorene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	<0.00005	-	0.00006	-	<0.00005	-	0.00020	-	0.00012	-	<0.00005	mg/kg	TM4/PM30
Anthracene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	<0.00005	-	<0.00005	-	0.00008	-	0.00025	-	0.00008	-	<0.00005	mg/kg	TM4/PM30
Pyrene	<0.00005	-	<0.00005	-	0.00006	-	0.00023	-	0.00007	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	<0.00005	-	<0.00005	-	<0.00005	-	0.00012	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Chrysene	<0.00005	-	<0.00005	-	<0.00005	-	0.00012	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	0.00019	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005	-	<0.00005	-	0.00009	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	<0.00005	-	<0.00005	-	<0.00005	-	0.00006	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	<0.00273	-	<0.00273	-	<0.00273	-	<0.00273	-	<0.00273	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	0.00014	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	72	-	66^{SV}	-	62^{SV}	-	58^{SV}	-	67^{SV}	-	<0	%	TM4/PM30

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	95	96	97	98	99	100	101	102	103	104			
Sample ID	C.3.30.6MONTH - Leachate A2 (i)	C.3.30.6MONTH - Leachate A2 (ii)	A.1.6FP.3W - Leachate B2 (i)	A.1.6FP.3W - Leachate B2 (ii)	B.1.10.1WK - Leachate B2 (i)	B.1.10.1WK - Leachate B2 (ii)	B.2.10.4WK - Leachate B2 (i)	B.2.10.4WK - Leachate B2 (ii)	C.1.30.3DAY - Leachate B2 (i)	C.1.30.3DAY - Leachate B2 (ii)			
Depth	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	95	96	97	98	99	100	101	102	103	104			
Sample ID	C.3.30.6MONTH - Leachate A2 (i)	C.3.30.6MONTH - Leachate A2 (ii)	A.1.6FP.3W - Leachate B2 (i)	A.1.6FP.3W - Leachate B2 (ii)	B.1.10.1WK - Leachate B2 (i)	B.1.10.1WK - Leachate B2 (ii)	B.2.10.4WK - Leachate B2 (i)	B.2.10.4WK - Leachate B2 (ii)	C.1.30.3DAY - Leachate B2 (i)	C.1.30.3DAY - Leachate B2 (ii)			
Depth	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-	<1	-	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	279	109	847	844	91	217	641	223	624	703	<5	mg/kg	TM38/PM0
Chloride	12	6	11	11	4	<3	<3	<3	29	32	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	4	<2	4	2	3	<2	3	<2	4	3	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM38/PM0
pH	11.7	11.4	10.4	10.5	9.39	9.24	8.98	9.10	11.3	11.2	<0.01	pH units	TM73/PM0

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All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential	**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub	
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	105	106	107	108							LOD/LOR	Units	Method No.
Sample ID	C.2.30.1WK - Leachate B2 (i)	C.2.30.1WK - Leachate B2 (ii)	C.3.30.6MONTH - Leachate B2 (i)	C.3.30.6MONTH - Leachate B2 (ii)									
Depth	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm									
COC No / misc													
Containers	T	T	T	T									
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022									
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate									
Batch Number	1	1	1	1									
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022									
Dissolved Aluminium (A10)	3.4	3.5	21.3	21.4							<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.06	0.03	<0.02	0.03							<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025							<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.09	0.10	0.13	0.13							<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005							<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	722	807	713	744							<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.388	0.392	0.160	0.168							<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07							<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05							<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01							<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	0.04	0.05	<0.02	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	97	100	85	90							<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03							<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.264	0.260	0.046	0.043							<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03							<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	0.002	-	<0.001	-							<0.001	mg/kg	TM4/PM30
Acenaphthylene	0.00005	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00041	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Fluorene	0.00016	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00050	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Anthracene	0.00007	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00025	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Pyrene	0.00021	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	0.00008	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Chrysene	0.00006	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	0.00013	-	<0.00008	-							<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	<0.00005	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	<0.00005	-	<0.00005	-							<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001	-							<0.001	mg/kg	TM4/PM30
PAH 17 Total	0.00392	-	<0.00273	-							<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	0.00009	-	<0.00008	-							<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	-	<0.00008	-							<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	73	-	68^{SV}	-							<0	%	TM4/PM30

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Client Name:	Geosyntec Consulting
Reference:	GCU0146045
Location:	Confidential
Contact:	Gareth Barns
EMT Job No:	22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	105	106	107	108							LOD/LOR	Units	Method No.
Sample ID	C.2.30.1WK - Leachate B2 (i)	C.2.30.1WK - Leachate B2 (ii)	C.3.30.6MONTH - Leachate B2 (i)	C.3.30.6MONTH - Leachate B2 (ii)									
Depth	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm									
COC No / misc													
Containers	T	T	T	T									
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022									
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate									
Batch Number	1	1	1	1									
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022									
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-							<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-							<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-							<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-							<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	105	106	107	108									
Sample ID	C.2.30.1WK - Leachate B2 (i)	C.2.30.1WK - Leachate B2 (ii)	C.3.30.6MONTH - Leachate B2 (i)	C.3.30.6MONTH - Leachate B2 (ii)									
Depth	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm									
COC No / misc													
Containers	T	T	T	T									
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022									
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate									
Batch Number	1	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022									
Total cresols	<0.3	-	<0.3	-							<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-							<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-							<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3							<3	mg/kg	TM173/PM0
Sulphate as SO4	1110	1280	132	123							<5	mg/kg	TM38/PM0
Chloride	30	28	14	16							<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	4	2	3	2							<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06							<0.06	mg/kg	TM38/PM0
pH	10.7	10.7	11.6	11.6							<0.01	pH units	TM73/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch (Duplicate results)

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	91												
Sample ID	C.1.30.3DAY - Leachate A2 (i)												
Depth	As Received												
COC No / misc													
Containers	T												
Sample Date	22/11/2022												
Sample Type	Aggregate												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022												
Dissolved Aluminium (A10)	8.6										<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.03										<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025										<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.11										<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005										<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	565										<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.097										<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07										<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05										<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01										<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	121										<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.185										<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03										<0.03	mg/kg	TM30/PM17
Sulphate as SO4	425										<5	mg/kg	TM38/PM0
Chloride	12										<3	mg/kg	TM38/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 22/19389						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/19389

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM16/PM30/PM69	please refer to PM16/PM30 and PM69 for method details			AR	Yes
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM17	Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM69	One part soil is mixed with 10 parts water in a vial leaving no headspace. The mixture is shaken and then left to leach for 24 hours before VOC analysis.			AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.			AR	Yes
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	Yes
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998)	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.			AR	

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Attention :	Gareth Barns
Date :	30th January, 2023
Your reference :	GCU0146045
Our reference :	Test Report 22/19389 Batch 1 Schedule E 22/19389 Batch 1 Schedule H
Location :	Confidential
Date samples received :	24th November, 2022
Status :	Final report
Issue :	2

Ninety samples were received for analysis on 24th November, 2022 of which twenty four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Simon Gomery BSc
Project Manager

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	109	110	111	112	113	114	115	116	117	118			
Sample ID	A.1.6FP.3W - Leachate A3 (i)	A.1.6FP.3W - Leachate A3 (ii)	B.1.10.1WK - Leachate A3 (i)	B.1.10.1WK - Leachate A3 (ii)	B.2.10.4WK - Leachate A3 (i)	B.2.10.4WK - Leachate A3 (ii)	C.1.30.3DAY - Leachate A3 (i)	C.1.30.3DAY - Leachate A3 (ii)	C.2.30.1WK - Leachate A3 (i)	C.2.30.1WK - Leachate A3 (ii)			
Preparation	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	0.9	0.5	2.7	2.3	2.7	2.1	8.0	3.2	1.6	3.6	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.04	0.05	<0.02	<0.02	0.03	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	0.032	<0.025	<0.025	<0.025	0.032	<0.025	<0.025	0.095	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.09	0.07	<0.03	<0.03	<0.03	<0.03	0.09	0.55	0.06	0.05	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	305	258	82	76	75	91	473	7680	536	469	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.075	0.050	<0.015	<0.015	<0.015	<0.015	0.071	0.088	0.140	0.139	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	0.09	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	75	75	3	6	5	7	66	97	49	46	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.194	0.178	0.022	0.035	0.022	<0.015	0.167	0.120	0.257	0.239	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	<0.001	-	<0.001	-	0.003	-	<0.001	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	<0.00005	-	<0.00005	-	<0.00005	-	0.00045	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00035	-	<0.00005	-	0.00009	-	0.00181	-	0.00026	-	<0.00005	mg/kg	TM4/PM30
Fluorene	0.00019	-	<0.00005	-	0.00009	-	0.00196	-	0.00008	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00036	-	<0.00005	-	0.00026	-	0.01350	-	0.00047	-	<0.00005	mg/kg	TM4/PM30
Anthracene	<0.00005	-	<0.00005	-	<0.00005	-	0.00437	-	0.00011	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00020	-	<0.00005	-	0.00025	-	0.02230	-	0.00051	-	<0.00005	mg/kg	TM4/PM30
Pyrene	0.00018	-	0.00007	-	0.00025	-	0.01780	-	0.00047	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	0.00008	-	<0.00005	-	0.00015	-	0.00919	-	0.00022	-	<0.00005	mg/kg	TM4/PM30
Chrysene	0.00010	-	<0.00005	-	0.00015	-	0.00908	-	0.00024	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	0.00015	-	<0.00008	-	0.00024	-	0.01710	-	0.00044	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005	-	<0.00005	-	0.00806	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	0.00005	-	<0.00005	-	0.00006	-	0.00586	-	0.00012	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005	-	<0.00005	-	0.00077	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	0.00006	-	<0.00005	-	0.00007	-	0.00409	-	0.00010	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	<0.00273	-	<0.00273	-	<0.00273	-	0.11934	-	0.00302	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	0.00011	-	<0.00008	-	0.00017	-	0.01230	-	0.00032	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	-	<0.00008	-	<0.00008	-	0.00479	-	0.00012	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	74	-	73	-	80	-	85	-	76	-	<0	%	TM4/PM30

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch**
Reference:	GCU0146045		
Location:	Confidential	**Solids:** V=60g VOC jar, J=250g glass jar, T=plastic tub	
Contact:	Gareth Barns		
EMT Job No:	22/19389		

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	109	110	111	112	113	114	115	116	117	118			
Sample ID	A.1.6FP.3W - Leachate A3 (i)	A.1.6FP.3W - Leachate A3 (ii)	B.1.10.1WK - Leachate A3 (i)	B.1.10.1WK - Leachate A3 (ii)	B.2.10.4WK - Leachate A3 (i)	B.2.10.4WK - Leachate A3 (ii)	C.1.30.3DAY - Leachate A3 (i)	C.1.30.3DAY - Leachate A3 (ii)	C.2.30.1WK - Leachate A3 (i)	C.2.30.1WK - Leachate A3 (ii)			
Preparation	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	109	110	111	112	113	114	115	116	117	118			
Sample ID	A.1.6FP.3W - Leachate A3 (i)	A.1.6FP.3W - Leachate A3 (ii)	B.1.10.1WK - Leachate A3 (i)	B.1.10.1WK - Leachate A3 (ii)	B.2.10.4WK - Leachate A3 (i)	B.2.10.4WK - Leachate A3 (ii)	C.1.30.3DAY - Leachate A3 (i)	C.1.30.3DAY - Leachate A3 (ii)	C.2.30.1WK - Leachate A3 (i)	C.2.30.1WK - Leachate A3 (ii)			
Preparation	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received	As Received			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-	<1	-	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	582	432	13	23	21	18	336	14300	867	533	<5	mg/kg	TM38/PM0
Chloride	<3	<3	<3	<3	<3	<3	5	11	3	6	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	3	<2	<2	<2	<2	<2	2	<2	3	<2	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM38/PM0
pH	9.88	10.0	8.23	9.45	9.27	8.36	11.1	11.1	10.2	10.7	<0.01	pH units	TM73/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	119	120	121	122	123	124	125	126	127	128			
Sample ID	C.3.30.6MONTH - Leachate A3 (i)	C.3.30.6MONTH - Leachate A3 (ii)	A.1.6FP.3W - Leachate B3 (i)	A.1.6FP.3W - Leachate B3 (ii)	B.1.10.1WK - Leachate B3 (i)	B.1.10.1WK - Leachate B3 (ii)	B.2.10.4WK - Leachate B3 (i)	B.2.10.4WK - Leachate B3 (ii)	C.1.30.3DAY - Leachate B3 (i)	C.1.30.3DAY - Leachate B3 (ii)			
Preparation	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Dissolved Aluminium (A10)	15.8	20.1	1.1	0.4	1.5	1.6	1.7	1.9	4.3	5.4	<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.04	<0.02	<0.02	0.04	<0.02	<0.02	0.03	<0.02	0.03	0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025	0.033	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.11	0.10	0.05	0.07	0.03	<0.03	<0.03	<0.03	0.06	0.06	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	750	631	204	320	89	83	91	80	414	409	<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.089	0.112	0.066	0.115	<0.015	<0.015	<0.015	<0.015	0.125	0.105	<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02	<0.02	<0.02	<0.02	0.03	0.03	0.03	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	48	58	62	72	6	8	7	7	91	88	<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.059	0.107	0.133	0.156	0.042	0.045	0.034	0.025	0.202	0.195	<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
Acenaphthylene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00006	-	0.00010	-	<0.00005	-	0.00016	-	0.00015	-	<0.00005	mg/kg	TM4/PM30
Fluorene	<0.00005	-	0.00011	-	<0.00005	-	0.00100	-	0.00011	-	<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00022	-	0.00045	-	<0.00005	-	0.00052	-	0.00038	-	<0.00005	mg/kg	TM4/PM30
Anthracene	0.00007	-	<0.00005	-	<0.00005	-	0.00010	-	0.00005	-	<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00056	-	0.00015	-	0.00007	-	0.00075	-	0.00033	-	<0.00005	mg/kg	TM4/PM30
Pyrene	0.00053	-	0.00013	-	0.00007	-	0.00073	-	0.00029	-	<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	0.00027	-	<0.00005	-	0.00005	-	0.00034	-	0.00013	-	<0.00005	mg/kg	TM4/PM30
Chrysene	0.00036	-	0.00006	-	0.00005	-	0.00036	-	0.00015	-	<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	0.00060	-	<0.00008	-	<0.00008	-	0.00058	-	0.00025	-	<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005	-	<0.00005	-	0.00020	-	0.00010	-	<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	0.00020	-	<0.00005	-	<0.00005	-	0.00015	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	0.00016	-	<0.00005	-	<0.00005	-	0.00014	-	0.00008	-	<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM4/PM30
PAH 17 Total	0.00303	-	<0.00273	-	<0.00273	-	0.00503	-	<0.00273	-	<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	0.00043	-	<0.00008	-	<0.00008	-	0.00042	-	0.00018	-	<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	0.00017	-	<0.00008	-	<0.00008	-	0.00016	-	<0.00008	-	<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	73	-	76	-	76	-	72	-	78	-	<0	%	TM4/PM30

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	119	120	121	122	123	124	125	126	127	128			
Sample ID	C.3.30.6MONTH - Leachate A3 (i)	C.3.30.6MONTH - Leachate A3 (ii)	A.1.6FP.3W - Leachate B3 (i)	A.1.6FP.3W - Leachate B3 (ii)	B.1.10.1WK - Leachate B3 (i)	B.1.10.1WK - Leachate B3 (ii)	B.2.10.4WK - Leachate B3 (i)	B.2.10.4WK - Leachate B3 (ii)	C.1.30.3DAY - Leachate B3 (i)	C.1.30.3DAY - Leachate B3 (ii)			
Preparation	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	-	<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	-	<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	-	<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	-	<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	119	120	121	122	123	124	125	126	127	128	LOD/LOR	Units	Method No.
Sample ID	C.3.30.6MONTH - Leachate A3 (i)	C.3.30.6MONTH - Leachate A3 (ii)	A.1.6FP.3W - Leachate B3 (i)	A.1.6FP.3W - Leachate B3 (ii)	B.1.10.1WK - Leachate B3 (i)	B.1.10.1WK - Leachate B3 (ii)	B.2.10.4WK - Leachate B3 (i)	B.2.10.4WK - Leachate B3 (ii)	C.1.30.3DAY - Leachate B3 (i)	C.1.30.3DAY - Leachate B3 (ii)			
Preparation	As Received	As Received	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate	Aggregate			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022	24/11/2022			
Total cresols	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	-	<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	-	<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-	<1	-	<1	-	<1	-	<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	mg/kg	TM173/PM0
Sulphate as SO4	215	219	302	510	35	28	25	18	330	278	<5	mg/kg	TM38/PM0
Chloride	5	4	6	<3	<3	<3	<3	<3	11	12	<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	<2	<2	<2	<2	<2	<2	<2	<2	2	<2	<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM38/PM0
pH	11.6	11.4	9.84	10.2	8.94	9.44	8.66	9.41	11.0	11.0	<0.01	pH units	TM73/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	129	130	131	132							LOD/LOR	Units	Method No.
Sample ID	C.2.30.1WK - Leachate B3 (i)	C.2.30.1WK - Leachate B3 (ii)	C.3.30.6MONTH - Leachate B3 (i)	C.3.30.6MONTH - Leachate B3 (ii)									
Preparation	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm									
COC No / misc													
Containers	T	T	T	T									
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022									
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate									
Batch Number	1	1	1	1									
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022									
Dissolved Aluminium (A10)	1.3	1.6	15.8	15.4							<0.2	mg/kg	TM30/PM17
Dissolved Antimony (A10)	0.02	0.02	0.03	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Arsenic (A10)	<0.025	<0.025	<0.025	<0.025							<0.025	mg/kg	TM30/PM17
Dissolved Barium (A10)	0.04	0.05	0.09	0.08							<0.03	mg/kg	TM30/PM17
Dissolved Cadmium (A10)	<0.005	<0.005	<0.005	<0.005							<0.005	mg/kg	TM30/PM17
Dissolved Calcium (A10)	382	422	605	625							<2	mg/kg	TM30/PM17
Dissolved Chromium (A10)	0.129	0.139	0.106	0.102							<0.015	mg/kg	TM30/PM17
Dissolved Copper (A10)	<0.07	<0.07	<0.07	<0.07							<0.07	mg/kg	TM30/PM17
Dissolved Lead (A10)	<0.05	<0.05	<0.05	<0.05							<0.05	mg/kg	TM30/PM17
Dissolved Mercury (A10)	<0.01	<0.01	<0.01	<0.01							<0.01	mg/kg	TM30/PM17
Dissolved Molybdenum (A10)	<0.02	<0.02	<0.02	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Nickel (A10)	<0.02	<0.02	<0.02	<0.02							<0.02	mg/kg	TM30/PM17
Dissolved Potassium (A10)	49	53	84	91							<1	mg/kg	TM30/PM17
Dissolved Selenium (A10)	<0.03	<0.03	<0.03	<0.03							<0.03	mg/kg	TM30/PM17
Dissolved Vanadium (A10)	0.295	0.284	0.085	0.089							<0.015	mg/kg	TM30/PM17
Dissolved Zinc (A10)	<0.03	<0.03	<0.03	<0.03							<0.03	mg/kg	TM30/PM17
PAH MS													
Naphthalene	<0.001	-	<0.001^{SV}	-							<0.001	mg/kg	TM4/PM30
Acenaphthylene	0.00006	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Acenaphthene	0.00015	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Fluorene	<0.00005	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Phenanthrene	0.00027	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Anthracene	0.00008	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Fluoranthene	0.00033	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Pyrene	0.00029	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Benzo(a)anthracene	0.00014	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Chrysene	0.00015	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Benzo(bk)fluoranthene	0.00024	-	<0.00008^{SV}	-							<0.00008	mg/kg	TM4/PM30
Benzo(a)pyrene	<0.00005	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Indeno(123cd)pyrene	0.00006	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Dibenzo(ah)anthracene	<0.00005	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Benzo(ghi)perylene	0.00006	-	<0.00005^{SV}	-							<0.00005	mg/kg	TM4/PM30
Coronene	<0.001	-	<0.001^{SV}	-							<0.001	mg/kg	TM4/PM30
PAH 17 Total	<0.00273	-	<0.00273^{SV}	-							<0.00273	mg/kg	TM4/PM30
Benzo(b)fluoranthene	0.00017	-	<0.00008	-							<0.00008	mg/kg	TM4/PM30
Benzo(k)fluoranthene	<0.00008	-	<0.00008	-							<0.00008	mg/kg	TM4/PM30
PAH Surrogate % Recovery	73	-	52^{SV}	-							<0	%	TM4/PM30

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	129	130	131	132									
Sample ID	C.2.30.1WK - Leachate B3 (i)	C.2.30.1WK - Leachate B3 (ii)	C.3.30.6MONTH - Leachate B3 (i)	C.3.30.6MONTH - Leachate B3 (ii)									
Preparation	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm									
COC No / misc													
Containers	T	T	T	T									
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022									
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate									
Batch Number	1	1	1	1							LOD/LOR	Units	Method No.
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022									
TPH CWG													
Aliphatics													
>C5-C6	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>C6-C8	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>C8-C10	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>C10-C12	<0.05	-	<0.05	-							<0.05	mg/kg	TM5/PM16/PM30
>C12-C16	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>C16-C21	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>C21-C35	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>C35-C44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
Total aliphatics C5-44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Aromatics													
>C5-EC7	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>EC7-EC8	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>EC8-EC10	<0.1	-	<0.1	-							<0.1	mg/kg	TM36/PM69
>EC10-EC12	<0.05	-	<0.05	-							<0.05	mg/kg	TM5/PM16/PM30
>EC12-EC16	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>EC16-EC21	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>EC21-EC35	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
>EC35-EC44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/PM16/PM30
Total aromatics C5-44	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
Total aliphatics and aromatics(C5-44)	<0.1	-	<0.1	-							<0.1	mg/kg	TM5/TM36/PM16/PM30/PM69
MTBE	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
Benzene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
Toluene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
Ethylbenzene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
m/p-Xylene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
o-Xylene	<0.05	-	<0.05	-							<0.05	mg/kg	TM36/PM69
PCB 28	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 52	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 101	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 118	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 138	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 153	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
PCB 180	<0.001	-	<0.001	-							<0.001	mg/kg	TM17/PM30
Total 7 PCBs	<0.007	-	<0.007	-							<0.007	mg/kg	TM17/PM30
Resorcinol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
Catechol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
Phenol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
m/p-cresol	<0.2	-	<0.2	-							<0.2	mg/kg	TM26/PM0
o-cresol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns
EMT Job No: 22/19389

Report : **CEN 10:1 1 Batch**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	129	130	131	132							LOD/LOR	Units	Method No.
Sample ID	C.2.30.1WK - Leachate B3 (i)	C.2.30.1WK - Leachate B3 (ii)	C.3.30.6MONTH - Leachate B3 (i)	C.3.30.6MONTH - Leachate B3 (ii)									
Preparation	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm	BS12457 95%<4mm									
COC No / misc													
Containers	T	T	T	T									
Sample Date	22/11/2022	22/11/2022	22/11/2022	22/11/2022									
Sample Type	Aggregate	Aggregate	Aggregate	Aggregate									
Batch Number	1	1	1	1									
Date of Receipt	24/11/2022	24/11/2022	24/11/2022	24/11/2022									
Total cresols	<0.3	-	<0.3	-							<0.3	mg/kg	TM26/PM0
Xylenols	<0.6	-	<0.6	-							<0.6	mg/kg	TM26/PM0
1-naphthol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
2,3,5-trimethyl phenol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
2-isopropylphenol	<0.1	-	<0.1	-							<0.1	mg/kg	TM26/PM0
Total Speciated Phenols HPLC	<1	-	<1	-							<1	mg/kg	TM26/PM0
Fluoride	<3	<3	<3	<3							<3	mg/kg	TM173/PM0
Sulphate as SO4	511	601	194	169							<5	mg/kg	TM38/PM0
Chloride	<3	3	12	11							<3	mg/kg	TM38/PM0
Dissolved Organic Carbon	2	<2	2	<2							<2	mg/l	TM60/PM0
Hexavalent Chromium	<0.06	<0.06	<0.06	<0.06							<0.06	mg/kg	TM38/PM0
pH	10.2	10.4	11.4	11.5							<0.01	pH units	TM73/PM0

Client Name:	Geosyntec Consulting	**Report :**	**CEN 10:1 1 Batch (Duplicate results)**
Reference:	GCU0146045		
Location:	Confidential	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Gareth Barns		
EMT Job No:	22/19389		

EMT Sample No.	116	118	LOD/LOR	Units	Method No.
Sample ID	C.1.30.3DAY - Leachate A3 (ii)	C.2.30.1WK - Leachate A3 (ii)			
Preparation	As Received	As Received			
COC No / misc					
Containers	T	T			
Sample Date	22/11/2022	22/11/2022			
Sample Type	Aggregate	Aggregate			
Batch Number	1	1			
Date of Receipt	24/11/2022	24/11/2022			
Dissolved Arsenic (A10)	-	0.032	<0.025	mg/kg	TM30/PM17
Dissolved Calcium (A10)	379	-	<2	mg/kg	TM30/PM17
Sulphate as SO4	925	-	<5	mg/kg	TM38/PM0

Please see attached notes for all abbreviations and acronyms

Client Name: Geosyntec Consulting
Reference: GCU0146045
Location: Confidential
Contact: Gareth Barns

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 22/19389						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/19389

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM16/PM30/PM69	please refer to PM16/PM30 and PM69 for method details			AR	Yes
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.			AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM17	Modified method BS EN12457-2:2002 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM69	One part soil is mixed with 10 parts water in a vial leaving no headspace. The mixture is shaken and then left to leach for 24 hours before VOC analysis.			AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013l	PM0	No preparation is required.			AR	Yes
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes

EMT Job No: 22/19389

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	Yes
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998)	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.			AR	