Assured Biosolids Limited
Biosolids Assurance Scheme

STANDARD GUIDANCE NOTES

GUIDANCE NOTES FOR

BAS APPLICANTS AND MEMBERS

AND THE CERTIFICATION BODY

Issue number: 3

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Document purpose and overview

These Standard Guidance Notes are intended as supporting documents to the BAS Standard to provide background information on more complex topics. They may be used as a reference for auditing purposes providing more information than is contained in the BAS Standard itself. Some information in the Standard Guidance Notes provides templates that may be used as the basis for providing evidence to the auditor.

These Standard Guidance Notes have been updated to align with Issue 5 of the BAS Standard (published 10 July 2020) and provide increased information and clarity for BAS Applicants, Members and the Certification Body. As such, the numbering in this document no longer matches the cross-references in BAS Standard Issue 4 (published 13th November 2017), which may be used for BAS audits until 30th September 2020.

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1. Trade Effluents Prescribed Substances

The following substances are taken from the Trade Effluents (Prescribed Processes and Substances) Regulations 1989 – Statutory Instrument 1156:

SCHEDULE 1 – PRESCRIBED SUBSTANCES

- Mercury and its compounds
- Cadmium and its compounds
- gamma-Hexachlorocyclohexane
- DDT
- Pentachlorophenol
- Hexachlorobenzene
- Hexachlorobutadiene
- Aldrin
- Dieldrin
- Endrin
- Carbon Tetrachloride
- Polychlorinated Biphenyls
- Dichlorvos
- 1, 2-Dichloroethane
- Trichlorobenzene
- Atrazine
- Simazine
- Tributyltin compounds
- Triphenyltin compounds
- Trifluralin
- Fenitrothion
- Azinphos-methyl
- Malathion
- Endosulfan

2. Provision of Source Material Risk Assessments (SMRA) – outsourcing

Normally the BAS Applicant or Member would internally complete the SMRA forms. However, where the sludge producer is a separate organisation to the sludge treatment operator, the sludge producer should complete the SMRA (usually Category A form for domestic and industrial wastewaters) and present this to the sludge treatment operator. If the sludge treatment operator also operates the wastewater treatment works (WwTW), then they can complete the SMRA themselves.

3. Managing Hub & Satellite sites & transfers of sludge in the scope of the BAS audit

This guidance note is intended to provide clarification on the information that should be included on the Application for Audit form where part treated or treated sludge is transferred to another site for further treatment or completion of processing (usually dewatering) before recycling to agricultural land. This information will be helpful for the auditor and can be used as background detail behind the Certificate of Conformity. This guidance is not a Standard requirement and therefore should not be part of the audit process.

The guidance also provides protocols for various operational permutations that should ensure both industry consistency and conformance with the requirements of the Standard.

The Standard is centred on three linked processes; Treatment; Transport and Storage; and Application to agricultural land. The completion of treatment and any associated processing are integral to producing a quality product. Therefore, the site where treatment and processing are completed (the quality control point) is the site that should be entered on the both the Application for Audit form and the Certificate of Conformity. For most sites this is straightforward.

Definitions of Treatment and Processing

For the purposes of this guidance, Treatment is defined as the operational processes for sludge treatment that, specifically, significantly reduces health hazards resulting from its use so that it does not cause nuisance. These treatment processes are documented in the site HACCP Plan.

For the purposes of this guidance, Processing is defined as the operational processes that include processing that is not included in sludge treatment e.g. dewatering of treated biosolids.

Definitions of hubs and satellites sites

Hub sites are defined here as sites that receive part treated or treated sludge from satellite sites.

Satellite sites are defined here as sites that part treat or treat sludge with the output being transferred to a hub site for completion of treatment or processing (usually dewatering) and subsequently dispatch to land. Where satellite sites also recycle directly to land (e.g. liquid biosolids application in the 'open season') they should also be listed on the Application for Audit form as an independent treatment site.

Raw sludge transfers – point of clarification

It is accepted that inter-works (including inter-company) transfers of raw sludge are accommodated within the Source Material Risk Assessment (SMRA) (Category A Form) and enter the sludge treatment process before the receiving site HACCP validation input sample point. Note for inter-company transfers of raw sludge, the sending company, upon request, should send a copy of the relevant SMRA documents to the receiving company.

Part treated sludge transfers

Where there are inter-works (including inter-company) transfers of part treated sludge from the satellite site(s) to a hub site, for further treatment before dispatch to land, these treatment activities should be noted in the receiving hub site HACCP Plan including within the HACCP process validation procedure; the satellite site(s) HACCP Plan should integrate with the hub site HACCP Plan covering the process validation procedure; the satellite site(s) HACCP Plan should in effect become an appendix to the hub site HACCP Plan. It is most likely that the hub site will also treat and process indigenous sludge.

Satellite sites must conform with the requirements of the Standard; particularly Sections 1 (SMRA) and 2 (Treatment).

It is the responsibility of the BAS Applicant or Member to demonstrate quality controls on the blend of sludges (i.e. the proportions from each site, the permutations and where input samples are taken) and the impact this may have on hub site process validation procedure calculations or merged satellite site sludges. The calculations should include examples of mean $\log_{10}$ values (indigenous and satellite sludges) for the input sludges and a hub site mean $\log_{10}$ value for the output sample. Routine MAC testing should be used to support the integrity of the process validation procedure and it is recommended that routine MAC testing is done at the hub site on all biosolids.

In the case of inter-company transfers of part treated sludge the sending company, upon request, should provide a copy of the relevant SMRA and HACCP documents to the receiving company. The receiving company should assess the impact (if any) on their hub site HACCP Plan process validation procedure and other quality controls e.g. MAC testing.

During an operational crisis (e.g. during disruptive weather or plant failure), it may not be possible to pre-empt all transfer permutations, but every effort should be made to support the integrity of the biosolids product with retrospective validation calculations and routine MAC testing.

Treated sludge/biosolids transfers

Where there are inter-works (including inter-company) transfers of treated sludge/biosolids from the satellite site(s) to a hub site, usually for dewatering before dispatch to land, these activities should be noted in the receiving hub site HACCP Plan regarding quality controls (e.g. MAC testing). Where the hub site also treats and processes indigenous sludge the satellite site(s) treated sludge/biosolids will probably enter the process after treatment but before dewatering.

The satellite site(s) should have a HACCP Plan with a completed process validation procedure and these should be available for audit alongside the hub site HACCP Plan; the satellite site(s) HACCP Plan should in effect become an appendix the hub site HACCP Plan.

However, in some circumstances the hub site may only provide dewatering services for multiple satellite sites. Hub sites that do not undertake treatment but receive multiple satellite site sludges for dewatering and act as the quality control point for recycling to land, should provide a Summary HACCP Plan that can be used to demonstrate satisfactory process validation procedure calculations and quality control for the output biosolids i.e. MAC testing. The satellite site(s) must have a complete HACCP Plan and process validation procedure for material sent to hub sites for dewatering. Note if the hub site does not undertake treatment, it does not require a HACCP Plan as described in Section 2 of the Standard.

In the case of inter-company transfers of treated sludge/biosolids, the sending company, upon request, should provide a copy of the relevant SMRA and HACCP documents to the receiving company and the receiving company should assess the impact (if any) on their hub site HACCP Plan or Summary HACCP Plan and quality controls e.g. MAC testing.

General notes

Where a satellite site puts liquid treated sludge/biosolids to land in the 'open season' the site should be noted in the scope as a main Reference Processing Facility that can then be linked directly to transport and field operations (for the Chain of Conformity). It should also be listed as a satellite site for the 'closed season' when the treated sludge/biosolids is transferred to a hub site for dewatering and despatch to land from the hub site.

4. Screening of non-degradable material

The Code of Practice for the agricultural use of sewage sludge (1996) (section 7.1): Under Environmental Protection refers to "In particular, care must be taken to ensure, as far as is practicable, that non-degradable material such as plastics is screened out of the sludge before it is spread on farmland".

The BAS Standard (Section 1) Source Material Risk Assessment for Categories A, B and C (Appendix 1 of the Standard) requests the identification of potential physical hazards; at this point the BAS Applicant or Member can identify e.g. rags, plastics, etc. A follow up question then asks what control measures are in place for these physical hazards; at this point the BAS Applicant or Member can identify e.g. screening on WwTW inlets and screening on raw sludge (including imports). It is up to the BAS Applicant or Member to answer these questions appropriately for their organisation.

Therefore, demonstrating that the Code of Practice requirement has been met can be achieved by appropriate completion of the Source Material Risk Assessment documents.

5. a) Effective Sludge Treatment Processes

Process	Descriptions
Pasteurisation	Sludge may be pasteurised typically at temperatures of 55°C for 4 hours or 70°C for 30 minutes.
Mesophilic Anaerobic Digestion (MAD)	Sludge is digested with the absence of oxygen by allowing naturally occurring bacteria to breakdown biodegradable material releasing methane and carbon dioxide. Temperatures are typically in the range 32 to 40°C with a retention time of around 12 to 30 days. Digested sludge may be held as batches (secondary digestion) at ambient temperature for typically a further 14 to 21 days to reduce microbiological parameters if no pre-treatment stage precedes digestion. Alternatively, to achieve a conventionally treated product (Safe Sludge Matrix) sludge can be stored as 'cake' (typically for 2 to 3 months) or lime may be added (see lime treatment).
Thermophilic Anaerobic Digestion	Sludge is digested with the absence of oxygen by allowing naturally occurring bacteria to breakdown biodegradable material releasing methane and carbon dioxide. Temperatures are typically around 55°C with a retention time of typically at least 7 days.
Advanced Anaerobic Digestion: Biological Hydrolysis	Prior to Mesophilic or Thermophilic Anaerobic Digestion (as above), sludge is held for around 2 to 3 days at temperatures of typically 38 to 42°C.
Advanced Anaerobic Digestion: Thermal Hydrolysis	Prior to Mesophilic or Thermophilic Anaerobic Digestion (as above), sludge is heated to around 160°C at 5.5 to 6 bar pressure for typically 30 to 45 minutes.
Lime treatment	Lime (e.g. calcium oxide, calcium hydroxide) can be used to reduce microbiological parameters by raising the pH (and temperature), for example >12 pH. Acceptable lime treatment methods are mechanically/electronically controlled processes that once set-up will repeat the process without human interaction/control (e.g. lime addition during/prior to dewatering, mixing screws or plough shares).
High temperature thermal drying	Sludge can be dried at high temperature (e.g. greater than 100°C) to reduce microbiological parameters and produce a granular or pellet product of typically 90 to 98% dry solids.
Composting	Sludge can be mixed with, for example green waste, woodchip or straw to add bulk and enable aeration. It is typically composted at 45 to 60°C for 2 to 4 weeks followed by a further 4 to 12 weeks stabilisation at lower temperatures. The initial high temperature phase should reduce microbiological parameters. Woodchip and other bulking materials can be screened out at the end of the treatment and reused for further composting.

Note: the example/typical Critical Limits shown above are for illustrative purposes; BAS Applicants or Members must set their own limits as part of their validated HACCP plans.

5. b) Effective Sludge Treatment Processes – lime mixing methods

The Code of Practice does not specify acceptable methods of lime treatment; it only refers to examples of effective sludge treatment processes. Many lime treatments operations use a method of mechanical/electronic controlled mixing (e.g. lime addition during/prior to dewatering, mixing screws or plough shares); however, some lime treatment operations use a manual or human controlled process (e.g. a machine (such as tractor, loading shovel, telehandler) mounted bucket) to mix the lime with raw sludge cake.

Acceptable lime mixing methods are mechanically/electronically controlled processes that once set-up will repeat the process without human interaction/control (e.g. lime addition during/prior to dewatering, mixing screws or plough shares). Unacceptable mixing methods are those which are manually controlled (e.g. bucket mixing using a tractor or any similar equipment). This is due to concerns around the homogeneity of the final biosolids product, how reliably this can be achieved and how effectively an inherently variable process can be validated and therefore form part of a satisfactory HACCP process.

From 1st July 2019 only acceptable methods of lime treatment will be allowable within the BAS Standard.

6. Treatment Site Risk Control form guidance

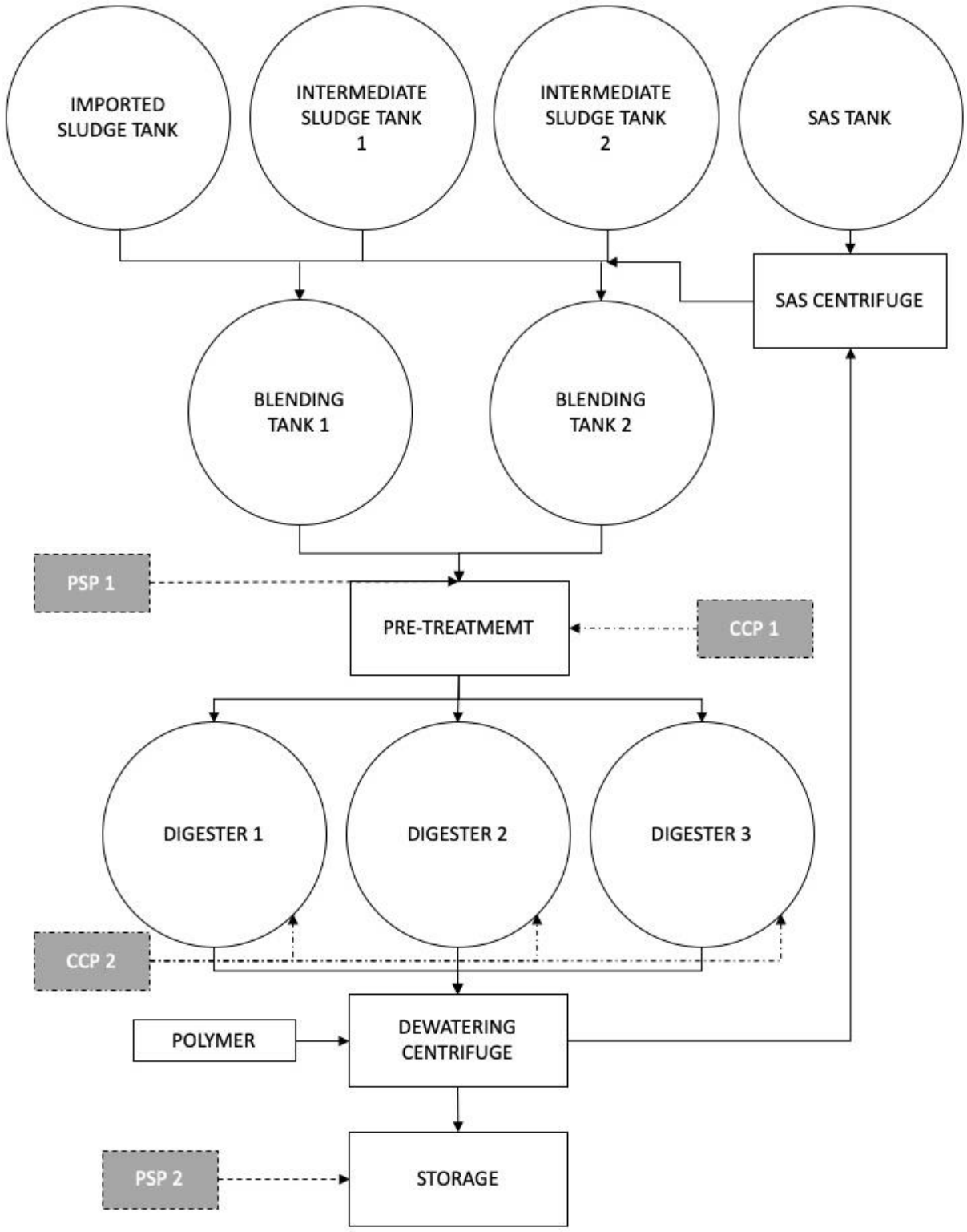
Treatment processes and the location of Reference Processing Facilities (i.e. treatment sites and any other site that processes sludge/biosolids) have the potential, if not properly managed, to negatively impact the environment, and human and animal health. As such the Treatment Site Risk Control (TSRC) form has been introduced to ensure these activities are suitably controlled.

Risk assessments, when required by the TSRC form, should be as detailed and complex as required to ensure the BAS Applicant or Member is confident that the Referenced Processing Facility does not pose an undue risk to the environment or local receptors.

With regards the specific sections of the TSRC form:

- Waste Authorisation: this is to ensure the Referenced Processing Facility is operating with some form of authorisation (and therefore will be meeting the required conditions), hence why a 'Yes' is required.
- Management Controls: this is to ensure the BAS Applicant or Member has a system in place to consider environmental risks and the Referenced Processing Facilities have been assessed under that system. Also if any risks have been identified, suitable mitigations are in place to minimise them.
- Suitably Capable Person: this is to ensure the BAS Applicant or Member has determined that the staff operating the Referenced Processing Facility are competent and appropriately trained/experienced. This does not necessarily mean they must hold a formal qualification, but that they are suitably capable of operating the facility.
- Sensitive Receptors: this is to ensure the BAS Applicant or Member has undertaken a risk assessment, if applicable, to identify and as required mitigate and minimise any risk to the environment, and human and animal health.

7. a) HACCP Process Schematic example

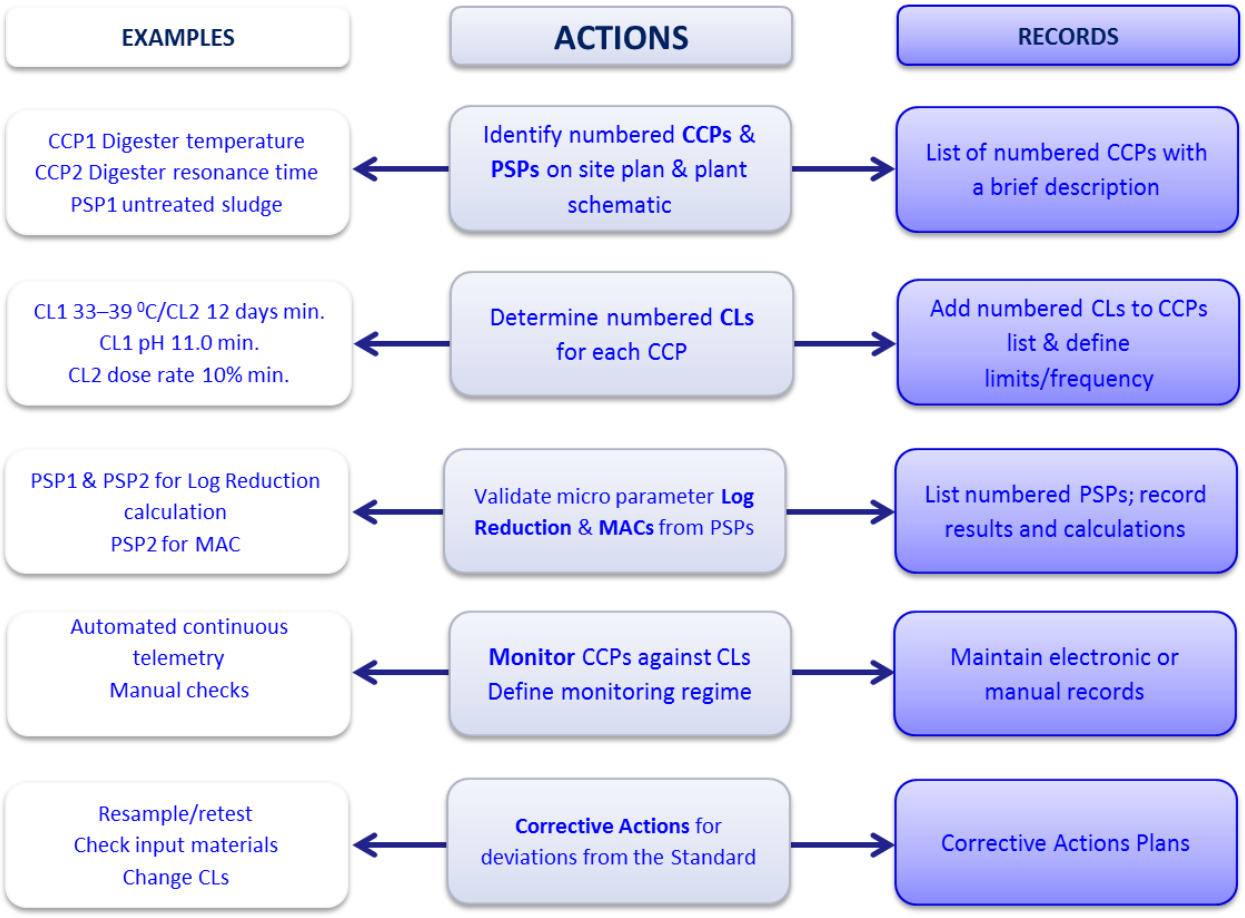


7. b) HACCP Plan Action and Records schematic

Site HACCP plans should be based on the Water UK HACCP guidance document; *The application of HACCP procedures in the water industry: biosolids treatment and use on agricultural land* (WRc, 2004) and conform to the BAS Standard.

HACCP plans may contain more information than is required by the BAS Standard. This additional voluntary information is not part of the Standard and should not be part of the BAS audit.

The schematic shows the ACTIONS as part of a HACCP plan that must be demonstrable to the auditor with associated RECORDS as determined by the Standard. Note the EXAMPLES are only a guide as to what information or activity may be seen.



CCP = Critical Control Point, CL = Critical Limit, PSP = Process Sample Point, MAC = Maximum Allowable Concentration

The table below shows a checklist that may be used as a guide for audit preparation.

	Site Plan	Plant Schematic	Numbering	List & describe	Records
CCPs	✓	✓	✓	✓	
CLs			✓	✓ & define frequency	
PSPs	✓	✓	✓	✓	
Monitor CCPs					✓
Process Validation					✓
Corrective Action Plan				✓	✓

7. c) Lime treatment controls and HACCP Plans

The Standard not only requires a HACCP process validation procedure (to achieve adequate pathogen kill), but also requires the treatment process to significantly reduce the fermentability and potential health hazards of the biosolids. This may be achieved by a robust approach to process controls that can demonstrate an effective sludge treatment process.

From 1st November 2019, to ensure that robust controls are maintained, a minimum of two Critical Control Points (CCPs) and their associated Critical limits (CLs) should be used to control lime treatment plants:

- At least one CCP must be a minimum lime inclusion rate (the method and rate to be determined by the BAS Applicant or Member).
- It is for BAS Applicant or Member to specify the other CCP(s).

This applies to all processes where lime is the primary treatment. Where lime is a secondary treatment and therefore 'topping-up' a primary treatment, the requirement for two CCPs on lime treatment does do not apply (for example, where lime is used after anaerobic digestion, anaerobic digestion is the primary treatment and lime addition is a secondary treatment). However, at least one CPP must be applied to lime treatment.

The HACCP Plan must record the process conditions at validation e.g. for lime neutralising value, lime quality (e.g. fineness of grind) and sludge dry solids, as well as microbiological data to provide a benchmark for subsequent or changed operations.

If the process conditions change significantly e.g. for lime neutralising value, lime quality (e.g. fineness of grind) or sludge dry solids, where there is likely to be a negative impact on the biosolids product conformity/quality, this should be accompanied by either an increase in Maximum Allowable Concentration (MAC) sampling frequency or by re-validation (as required by the Standard), depending on the significance of the change.

8. Final product sampling points

The continued conditioning of some products may beneficially reduce the level of microbiological parameters (e.g. *E. coli*). Whereas for others it was considered that any delay in sampling, beyond the initial treatment process, would increase the likelihood of contamination from the external environment (e.g. from *salmonella spp.*). As such, alternative end product sampling points (Process Sample Points – PSPs) can be used for *salmonella spp.*, separate to those used for *E. coli* sampling.

Note: any additional PSPs should be identified in HACCP Plans (as per Standard section 2). Any alternative end product sampling points should be used for HACCP process validation as well as routine MAC testing. PSPs must be clearly labelled on site with either permanent or robust moveable signs to ensure samples are taken from the correct locations.

9. HACCP revalidation

After start-up (i.e. when a treatment process is initially commissioned) and the process validation procedure has been completed, if the treatment process has been stopped for equipment maintenance (e.g. digester cleaning) or equipment replacement, but this change does not alter the treatment type, the CCPs or CLs or is unlikely to negatively affect the quality of the biosolids, then there is no requirement to revalidate the process in the HACCP Plan. For example, a change in dewatering technology in most circumstances is unlikely to affect the CCPs and CLs or negatively affect biosolids quality. However, if a change is likely to negatively affect the quality of the biosolids, revalidation would be required.

Notwithstanding the above, as per the BAS Standard, validation must be repeated at least once every ten years.

10. Suitable sludge for validation

As detailed in the Glossary of these Standard Guidance Notes, the BAS recognises two types of untreated sludge: raw and non-validated. Untreated (raw) sludge is the most common, however, untreated (non-validated) sludge will be produced periodically and can be managed in the same way, with the exception of during HACCP process validation.

Treatment processes should be HACCP validated using untreated (raw) sludge where possible, due to the likely elevated microbiological loading and it probably being representative of the sludge to be treated on an ongoing basis. However, untreated (non-validated) sludge can be used during process validation, although if a process is validated using non-validated sludge it would only be able to treat untreated (non-validated) sludge on an ongoing basis. This is because subsequently accepting untreated (raw) sludge would then be deemed a significant change and would require the process to be re-validated using the significantly different sludge (i.e. untreated (raw) sludge).

11. Sampling Methods for Bulk Biosolids

Sample containers:

Sample containers should be clean and clearly labelled with details including site, batch reference and date.

Representative sampling methods (modified from RB209) and sample preparation for analysis of micro-biological parameters:

Cake in heaps:

Identify at least five locations which appear to be representative of the heap. After clearing away any weathered material with a spade or fork, dig a hole approximately 0.5 m deep and take a sample from each point. Samples can also be taken on mechanical movement of the heap (e.g. by tractor shovel).

Representative samples for analysis must be either:

i. A composite sample, which is then sub-sampled to provide 3 triplicate samples for analysis or;
ii. Five separate samples with each sample being analysed.

Thermally dried granules:

Identify at least five locations which appear to be representative of the bagged/bulk stored granules and take a sample from each point.

Representative samples for analysis must be either:

i. A composite sample, which is then sub-sampled to provide 3 triplicate samples for analysis or;
ii. Five separate samples with each sample being analysed.

Liquid digested:

Take at least five samples that represent each batch of liquid digested sludge. Representative samples for analysis must be either:

i. A composite sample, which is then sub-sampled to provide 3 triplicate samples for analysis or;
ii. Five separate samples with each sample being analysed.

Health and Safety:

Note: it is the responsibility of the BAS Applicant or Member and its contractors to ensure sampling is performed with due regard to health and safety requirements.

12. Process Validation Procedure data record example

Below are example process validation datasets. The key points are:

- They include 5 sampling events as required by the BAS Standard, although for process validations completed before 1st January 2015 3 sampling events are acceptable.
- Processes were deemed to be continuous processes and as such sampling events were completed on different days over a period between 10 – 60 days.
- There are 3 sample results per event (i.e. from a composite sample analysed in triplicate), however, an alternative could show 5 individual sample results per event.
- The mean sampling event results (in the second, fourth and sixth tables) are the mean of the $\log_{10}$ values across the individual samples.
- The overall $\log_{10}$ reduction results were calculated as the mean $\log_{10}$ result across all the sampling events (i.e. the mean of the $\log_{10}$ results for all the individual sampling events).
- gDS = grams dry solids.

Conventionally treated example process validation data record

Example analysis data

Untreated (raw) sludge input			Treated sludge/biosolids output		
Date	***E. coli*/gDS (natural)**	**Equivalent as log_{10}**	**Date**	***E. coli*/gDS *(natural)***	**Equivalent as log_{10}**
01/05/2019	4,000,000	6.60	01/05/2019	5,400	3.73
01/05/2019	6,000,000	6.78	01/05/2019	8,500	3.93
01/05/2019	6,500,000	6.81	01/05/2019	3,000	3.48
08/05/2019	2,500,000	6.40	08/05/2019	10,500	4.02
08/05/2019	4,000,000	6.60	08/05/2019	6,500	3.81
08/05/2019	4,000,000	6.60	08/05/2019	7,000	3.85
15/05/2019	4,000,000	6.60	15/05/2019	4,000	3.60
15/05/2019	5,000,000	6.70	15/05/2019	7,000	3.85
15/05/2019	5,000,000	6.70	15/05/2019	6,500	3.81
22/05/2019	6,000,000	6.78	22/05/2019	3,800	3.58
22/05/2019	5,000,000	6.70	22/05/2019	3,200	3.51
22/05/2019	3,000,000	6.48	22/05/2019	4,500	3.65
29/05/2019	2,500,000	6.40	29/05/2019	9,500	3.98
29/05/2019	6,000,000	6.78	29/05/2019	9,200	3.96
29/05/2019	3,400,000	6.53	29/05/2019	12,000	4.08

Example mean sampling event data

Untreated (raw) sludge input		Treated sludge/biosolids output		
Date	***E. coli*/gDS as log_{10}**	**Date**	***E. coli*/gDS as log_{10}**	**Log_{10} reduction**
01/05/2019	6.73	01/05/2019	3.71	**3.02**
08/05/2019	6.53	08/05/2019	3.89	**2.64**
15/05/2019	6.67	15/05/2019	3.75	**2.91**
22/05/2019	6.65	22/05/2019	3.58	**3.07**
29/05/2019	6.57	29/05/2019	4.01	**2.56**
			Overall log reduction	**2.84**

Results

- The mean log_{10} result of 2.84 achieves the conventionally treated standard being > 2 log_{10}

Enhanced treated example process validation data record

Example analysis data

Untreated (raw) sludge input			Treated sludge/biosolids output			
Date	***E. coli*/gDS (natural)**	**Equivalent as log_{10}**	**Date**	***E. coli*/gDS *(natural)***	**Equivalent as log_{10}**	***Salmonella spp.***
01/08/2019	35,000,000	7.54	01/08/2019	20	1.30	Absent
01/08/2019	30,000,000	7.48	01/08/2019	10	1.00	Absent
01/08/2019	46,000,000	7.66	01/08/2019	10	1.00	Absent
10/08/2019	50,000,000	7.70	10/08/2019	30	1.48	Absent
10/08/2019	25,000,000	7.40	10/08/2019	10	1.00	Absent
10/08/2019	48,000,000	7.68	10/08/2019	10	1.00	Absent
19/08/2019	30,000,000	7.48	19/08/2019	56	1.75	Absent
19/08/2019	25,000,000	7.40	19/08/2019	10	1.00	Absent
19/08/2019	27,000,000	7.43	19/08/2019	30	1.48	Absent
29/08/2019	25,000,000	7.40	29/08/2019	100	2.00	Absent
29/08/2019	85,000,000	7.93	29/08/2019	1,400	3.15	Absent
29/08/2019	34,000,000	7.53	29/08/2019	150	2.18	Absent
14/09/2019	25,000,000	7.40	14/09/2019	10	1.00	Absent
14/09/2019	30,000,000	7.48	14/09/2019	40	1.60	Absent
14/09/2019	35,000,000	7.54	14/09/2019	10	1.00	Absent

Example mean sampling event data

Untreated (raw) sludge input		Treated sludge/biosolids output		
Date	***E. coli*/gDS as log_{10}**	**Date**	***E. coli*/gDS as log_{10}**	**Log_{10} reduction**
01/08/2019	7.54	01/08/2019	1.10	**6.46**
10/08/2019	7.59	10/08/2019	1.16	**6.43**
19/08/2019	7.44	19/08/2019	1.41	**6.03**
29/08/2019	7.62	29/08/2019	2.44	**5.18**
14/09/2019	7.47	14/09/2019	1.20	**6.27**
			Overall log reduction	**6.07**

Results

- The mean log_{10} result of 6.07 achieves the enhanced treated standard being > 6 log_{10}

Second Enhanced treated example process validation data record

As referred to in the BAS Standard, demonstrating a 6 log_{10} reduction can be difficult. Where there is insufficient *E. coli* in the untreated sludge the validation process must still be followed, but the enhanced treated standard can be achieved if there is a mean of < 8.0 log_{10} *E. coli* in the untreated sludge and the results meet the Maximum Allowable Concentration (MAC).

Example analysis data

Untreated (raw) sludge input			Treated sludge/biosolids output			
Date	***E. coli*/gDS (natural)**	**Equivalent as log_{10}**	**Date**	***E. coli*/gDS *(natural)***	**Equivalent as log_{10}**	***Salmonella spp.***
15/04/2019	30,000,000	7.48	15/04/2019	850	2.93	Absent
15/04/2019	45,000,000	7.65	15/04/2019	720	2.86	Absent
15/04/2019	36,000,000	7.56	15/04/2019	600	2.78	Absent
28/04/2019	48,000,000	7.68	28/04/2019	500	2.70	Absent
28/04/2019	20,000,000	7.30	28/04/2019	45	1.65	Absent
28/04/2019	37,000,000	7.57	28/04/2019	900	2.95	Absent
10/05/2019	28,000,000	7.45	10/05/2019	650	2.81	Absent
10/05/2019	32,000,000	7.51	10/05/2019	780	2.89	Absent
10/05/2019	33,000,000	7.52	10/05/2019	900	2.95	Absent
29/05/2019	40,000,000	7.60	29/05/2019	350	2.54	Absent
29/05/2019	28,000,000	7.45	29/05/2019	970	2.99	Absent
29/05/2019	37,000,000	7.57	29/05/2019	660	2.82	Absent
10/06/2019	32,000,000	7.51	10/06/2019	250	2.40	Absent
10/06/2019	20,000,000	7.30	10/06/2019	560	2.75	Absent
10/06/2019	26,000,000	7.41	10/06/2019	480	2.68	Absent

Example mean sampling event data

Untreated (raw) sludge input		Treated sludge/biosolids output		**Log_{10} reduction**
Date	***E. coli*/gDS as log_{10}**	**Date**	***E. coli*/gDS as log_{10}**	
15/04/2019	7.56	15/04/2019	2.85	**4.71**
28/04/2019	7.52	28/04/2019	2.44	**5.08**
10/05/2019	7.49	10/05/2019	2.89	**4.60**
29/05/2019	7.54	29/05/2019	2.78	**4.76**
10/06/2019	7.41	10/06/2019	2.61	**4.80**
Mean	**7.52**	**Mean**	**2.71**	
			Overall log reduction	**4.79**

Results

- The mean log_{10} result of 4.79 doesn't achieve the Enhanced treated standard being < 6 log_{10}.
- The mean log_{10} of the output across the sampling events is 2.71 with an inverse log_{10} of 513 *E. coli*/gram dry solids. This is below the enhanced MAC of < 1,000 *E. coli*/gram dry solids and there is an absence of *salmonella spp*.
- The mean of the untreated sludge is 7.52 log_{10} *E.coli*, which is less than 8.0, so the process would qualify as enhanced treated.

13. Methods of Analysis

The BAS Standard previously referenced that all analytical methods were to be as per the Standing Committee of Analysts (SCA) 'blue book' methods. However, not all methods are covered within the 'blue books' and some have become out-of-date, although, some methods were under review at the time this Standard Guidance Note was published.

All analysis must be undertaken by a laboratory which features on the ABL Approved Laboratory List using a reputable method. Additionally and as per the ABL's Laboratory Protocol and Application Form, from 1st January 2020 laboratories must participate in a recognised proficiency testing scheme for all methods (in the relevant matrices) used by BAS Applicants and Members relating to sludge treatment and biosolids recycling to agricultural land.

14. MAC sample and hold versus quarantined biosolids

The BAS Standard requires that MAC samples are taken periodically, or more frequently in specific situations, to ensure the Critical Control Points (CCPs) and Critical Limits (CLs) are operating as effectively as when the process was validated. These samples reflect a 'belt and braces' approach and the need to sample in no way suggests the product is not sufficiently treated. In these situations, any sampled biosolids and any subsequent output can be transferred to permanent storage or temporary field storage but must not be applied to agricultural land until positive analytical testing has been received i.e. proof that the sample meets the appropriate MAC limit.

A short-hand term used to represent the routine MAC sampling procedure as described above is "sample and hold" and for the avoidance of doubt this is not quarantining, which has further implications.

Quarantining applies when a MAC sample fails i.e. where an analytical result shows the biosolids does not meet the relevant MAC. The biosolids, any subsequent biosolids and any material it has been added to must also be quarantined. Quarantining is a formal process which must involve record keeping relating to when and why material was quarantined, and what will be done to prevent it happening again. Quarantined material must not be taken to fields (for storage or spreading), biosolids already in field storage may be resampled, but must not be spread to agricultural land and if it fails to confirm after multiple retesting must be removed.

15. Use of permanent stores

Where biosolids are moved from the treatment site to other stores, before going to agricultural land, these sites must be identified as permanent stores if they are not field storage. The Application for Audit Form B requests these sites be listed to provide traceability on the biosolids route to land and the possibility of mixing with biosolids from other sources. The Standard allows storage in the curtilage of the treatment works. Storage in the curtilage of other treatment works or WwTW should be identified on Form B as permanent storage. All permanent storage sites must conform with the requirements of the Standard i.e. have an impermeable base, leachate collection and not be accessible to the public.

Contingency storage sites, as permanent stores, should be recorded in the Application for Audit Form B or as additional information with the application to ensure that these activities are in the scope of the audit and therefore will be within subsequent certification. It is acknowledged and accepted that not all permutations of biosolids movements through permanent stores can be predicted.

Where the certified treated biosolids and non-certified treated biosolids or non-conforming biosolids are kept separate in a permanent store, note the Application for Audit Form B requests further information be supplied on segregation.

If certified treated biosolids and non-certified treated biosolids or non-conforming biosolids do become combined in any way, they do become non-certified and will lose any certification status.

16. NVZ identification

The NVZ status of the storage and application land must be identified within records for each dispatch to land. Generic statements of NVZs not being relevant to a specific site are not acceptable.

17. Biosolids Transportation and Storage evidence document template (England and Wales)

The template can be made available to BAS Applicants and Members from ABL on request – please contact bas@assuredbiosolids.co.uk.

18. Biosolids Transportation and Storage evidence document template (Scotland)

The template can be made available to BAS Applicants and Members from ABL on request – please contact bas@assuredbiosolids.co.uk.

19. Soil sampling overview

19.1 Sampling Frequency

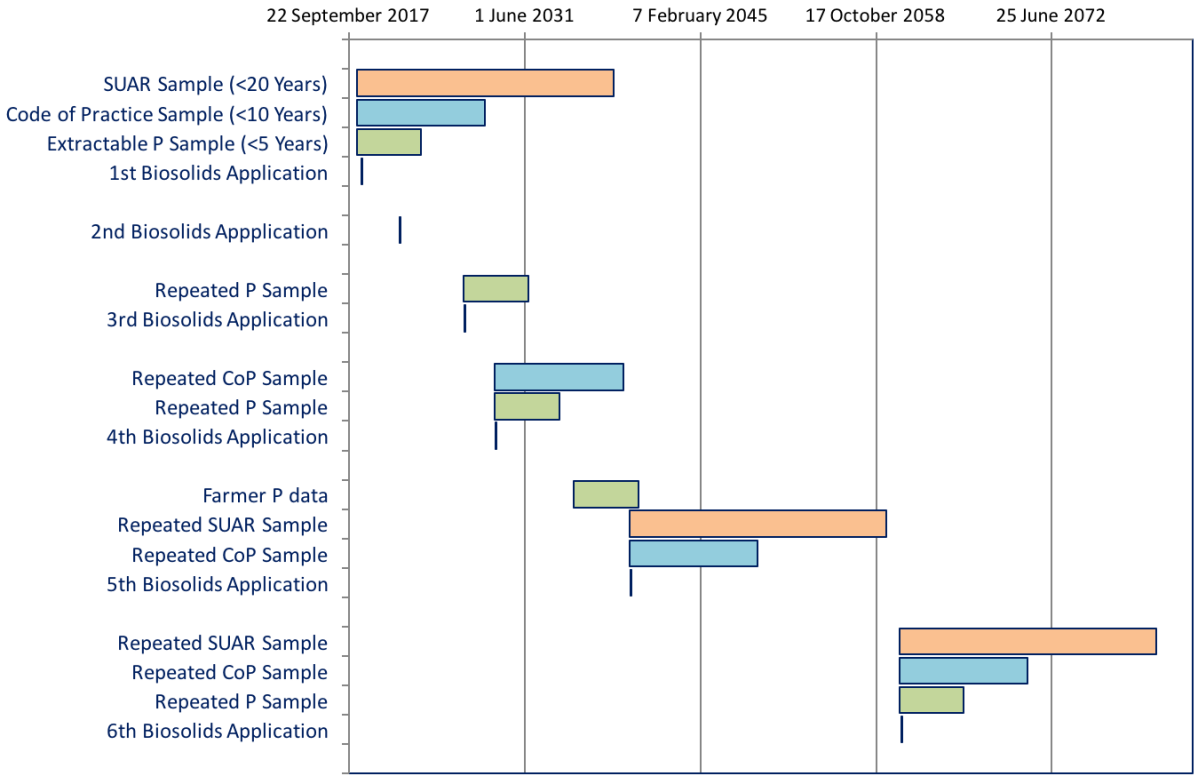
From the 1st January 2018, before biosolids can be applied there must be soil analysis data to demonstrate conformance with requirements of the BAS.

The frequency of sampling is described within the Standard requirement (Section 5), but in summary on the date biosolids is applied there must be evidence to demonstrate the following:

- A 25cm 'Regulatory' soil sample (or to the depth of the soil if less) analysed for pH, cadmium, chromium, copper, lead, mercury, nickel and zinc dated within 20 years once every 5 hectares and;
- A 15cm soil sample (or 7.5cm for non-rotational grass or in the case of liquid injection to the planned depth of injection) reflecting a uniform area (as a minimum) analysed for Extractable P dated within 5 years and;
- A 'Code of Practice' soil sample analysed for pH, cadmium, chromium, copper, lead, mercury, nickel, zinc, arsenic, fluoride, molybdenum and selenium dated within 10 years, on either:
    - A 15cm soil sample (or 7.5cm for non-rotational grass or in the case of liquid injection to the planned depth of injection) reflecting a uniform area (as a minimum) or;
    - A 25cm soil sample (or to the depth of the soil if less) once every 5 hectares.

These are the minimum requirements; more frequent (e.g. extractable P sampling every two years) or greater resolution (e.g. every hectare) is at the discretion of individual members.

Below is an illustrative example of a series of applications to a fictitious field. In each case the application is conforming with the minimum standards of the BAS.



19.2 Sampling Location and depths

The 'Regulatory' sample must be taken once for every 5 hectares to a depth of 25cm (or the depth of the soil if lesser).

Extractable P samples should reflect uniform areas (e.g. a whole field or split by soil type, field history, etc.) i.e. they do not have to be one for every 5 hectares; so, the sampling rate could be higher or lower than once for every 5 hectares. Samples must be 15cm for arable land or 7.5cm for non-rotational grass (or in the case of liquid injection to the planned depth of injection).

'Code of Practice' samples can either be taken one of two ways:

- From a uniform area (following the Extractable P method) to 15cm for arable or 7.5cm for non-rotational grass (or in the case of liquid injection, to the planned depth of injection) or;
- Every 5 hectares (following the Sludge Regulations method) to 25cm or the depth of the soil whichever is the lesser.

Below is an illustrative example of some fields. In each case the approach is conforming with the minimum requirements of the BAS.

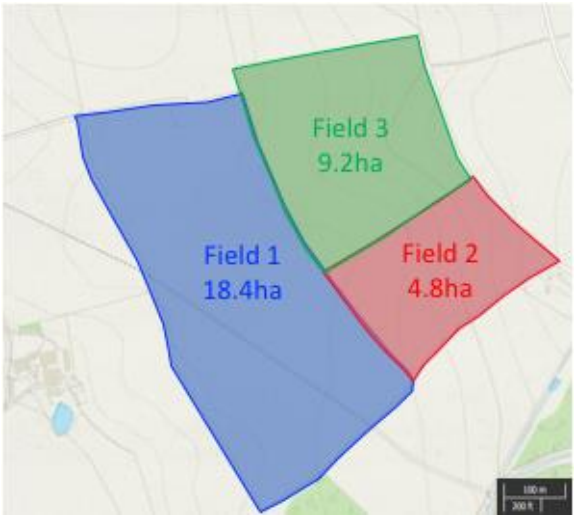


Figure 1. Example Fields

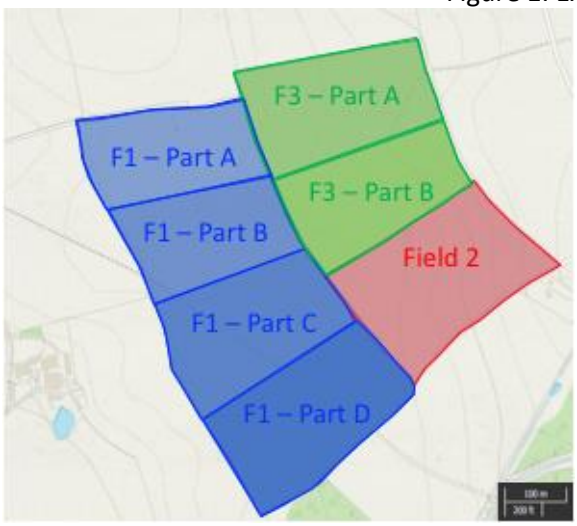


Figure 2. 5 hectare area basis

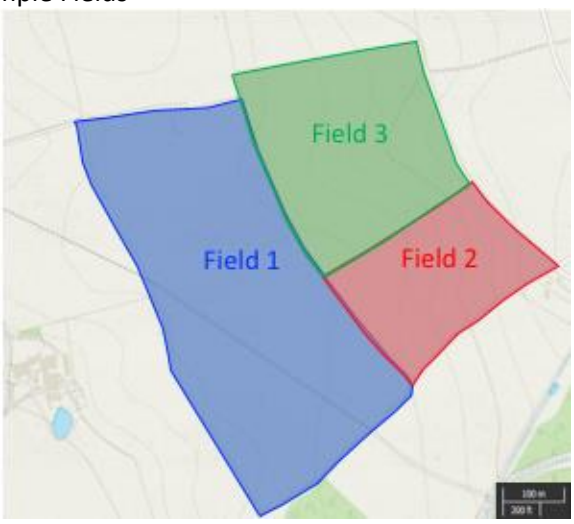


Figure 3. Uniform area basis (as a minimum)

19.3 Extractable P Sampling

Sample depths

For Extractable P samples and Code of Practice (where appropriate) arable soils should be sampled to 15cm and grass to 7.5cm. Arable land includes temporary grass, which is deemed to be less than 5 years old.

For the BAS Standard:

- Grass that is less than 5 years old should be identified as arable land and therefore should be sampled to 15cm and assessed against the arable land limits;
- Grass that is 5 years old or more should be sampled at 7.5cm and assessed against the grass limits;
- Where grass is grown in rotation with other crops, even if this rotational grass is sampled to 7.5cm the arable soil limits should be used (i.e. the more stringent limits) to ensure that arable soil limits are not exceeded.

Taking a representative sample

The soil sample must be representative of the area sampled. Areas of land known to differ in some important respects (e.g. soil type, previous cropping, applications of manures, fertiliser or lime) should be sampled separately. Small areas known to differ from the majority of a field should be excluded from the sample.

A sample of 25 individual sub-samples (cores) will be adequate for a uniform area. The sub-sampling points must be selected systematically, with an even distribution over the whole area. This may be achieved by following the pattern of a letter 'W' and taking sub-samples at regular intervals. Do not take samples in headlands, or in the immediate vicinity of hedges, trees or other unusual features.

Uniform areas and Soil P index

For larger fields where multiple samples are taken, if there are no significant differences in soil texture or historical management (e.g. cropping and applications of fertiliser and manure), then there is unlikely to be significant in-field variation in soil P Index. If the soil P Index varies across the field it may be appropriate to implement a varied fertiliser management plan that reflects the information gathered in sampling and analysis. If it is not possible to implement a variable management plan, biosolid application rates should be based on the highest P index measured across the application area. Averaging the soil P analysis results is not appropriate as it may lead to over application of biosolids P on areas with high soil P.

Precision farming sampling

A number of companies undertake the precision mapping of soil P (plus pH, K and Mg) status, usually based on one hectare blocks. In the case of manufactured fertiliser P and K inputs, variable rate applications are made to each one hectare (or group of one hectare blocks). In the case of biosolids application, such variable rate applications are not made presently, hence, the biosolids application policy should be based on the highest Soil P Index of each management unit, as this is the most representative approach for the unit of land.

19.4 Sampling equipment

A gouge corer or screw auger may be used when sampling in arable or vegetable systems, or for fruit, vines and hops.

In grassland systems or where the soil is not cultivated, only use a gouge or pot corer which can take an even core of soil throughout the sampling depth. This is not possible using a screw auger which should *not* be used in these situations.

20. Safe Sludge Matrix cropping categories

The following crop categories correspond to the Safe Sludge Matrix headings contained within the BAS Standard:

Fruit	Salad (e.g. ready to eat crops)	Vegetables	Horticulture	Combinable and animal feed crops	Grassland and forage	
					Harvested	Grazed
Top fruit (apples, pears, etc.) Stone fruit (plums, cherries etc.) Soft fruit (currants and berries) Vines Hops Nuts	Lettuce Radish Onions Beans (including runner, broad and dwarf French) Vining peas Mangetout Cabbage Cauliflower Calabrese/broccoli Courgettes Celery Red beet Carrots Herbs Asparagus Garlic Shallot Spinach Chicory Celeriac	Potatoes Leeks Sweetcorn Brussels sprouts Parsnips Swedes/turnips Marrows Pumpkins Squashes Rhubarb Artichokes	Soil based glasshouse and polythene tunnel production (including tomatoes, cucumbers, peppers etc.) Mushrooms Nursery stock and bulbs for export Basic nursery stock Seed potatoes for export Basic seed potatoes Basic seed production	Wheat Barley Oats Rye Triticale Field peas Field beans Linseed/flax Oilseed Sugar beet Sunflower Borage	Maize silage Grass silage Haylage Hay Herbage seeds	Grass Forage Swedes/turnips Fodder mangolds/ beet/kale Forage rye and Triticale Turf production

21. Fodder crops clarification

The BAS Standard, in simple terms, does not allow biosolids to be applied in spring/summer to some crops that animals will consume before they are affected by winter frosts – for the full requirements see Section 5 of the BAS Standard.

The purpose of this requirement is to protect animals from consuming tomato plants, whose seeds can survive sludge treatment. The Standard requirement intends stock fodder crops to mean kale or similar crops where stock could inadvertently consume rogue tomato plants before they can be killed by winter frost. Grass is not included as there is a reasonable assumption made that if tomato plants grew in grass, grazing livestock would avoid them.

22. Field Application evidence document template (England and Wales)

The template can be made available to BAS Applicants and Members from ABL on request – please contact bas@assuredbiosolids.co.uk.

23. Field Application evidence document template (Scotland)

The template can be made available to BAS Applicants and Members from ABL on request – please contact bas@assuredbiosolids.co.uk.

24. Biosolids Nutrient Management Matrix, 2019

Background

Under the Farming Rules for Water (2018) land managers must ensure that, for each application of organic manure or manufactured fertiliser to agricultural land, the application is planned so that it does not:

i) exceed the needs of the soil and crop on that land, or

ii) give rise to a significant risk of agricultural diffuse pollution

The "Sludge Use in Agricultural Regulations 1989", Section 3(7) requires that "The sludge shall be used in such a way that account is taken of the nutrient needs of the plants and that the quality of the soil and surface and groundwater is not impaired".

Recycling to land

Biosolids are a valuable source of two major crop available nutrients - nitrogen and phosphorus (plus sulphur, potassium, magnesium and trace elements, etc.), stable organic matter and lime, which can be beneficially recycled to agricultural land to improve soil quality and fertility, and to complete natural nutrient and carbon cycles. The recycling of biosolids to agricultural land is a necessary part of sustainable strategies for preserving the earth's natural resources (e.g. rock phosphate) and safeguarding future food security in the UK.

Biosolids recycling to agricultural land must comply with numerous pieces of legislation and best practice guidance:

- The Sludge (Use in Agriculture) Regulations;
- Code of Practice for Agricultural Use of Sewage Sludge;
- The ADAS Safe Sludge Matrix;
- The Nitrate Pollution Prevention Regulations;
- Codes of Good Agricultural Practice;
- AHDB's Nutrient Management Guide (RB209) – 9th edition;
- Biosolids Assurance Scheme

Nutrient (nitrogen and phosphate) Management Matrix

Research underpinning best practice guidance on the management of biosolids nutrients for optimum crop growth is summarised in AHDB's Nutrient Management Guide (RB209), Section 2, Organic Materials. The Biosolids Nutrient Management Matrix is consistent with good practice management advice (e.g. RB209).

The Biosolids Nutrient Management Matrix was introduced in 2014 to more clearly define good practice in biosolids management and to limit phosphorus (P) loadings to land from biosolids applications. Applying biosolids at a rate of 250 kg/ha total N will typically supply 200-350 kg/ha phosphate (P_2O_5) (depending on the type of biosolids being used). This means that the soil P status of individual fields may increase at the maximum potential application rates in the Matrix. If this occurs, the frequency of biosolids P applications would decrease and at ADAS soil P Index 5 applications would not be permitted. A comprehensive review of the Matrix was carried out by ADAS in 2019 which suggested that the frequency of applications of soils at P index 4 should be reduced.

It is important that the agronomic benefits (i.e. nitrogen, phosphate and organic matter etc.) gained from applying biosolids to land should be balanced with risks to soil and water quality and that any guidance is consistent with the requirements of the Farming Rules for Water. ADAS confirms that the revised Biosolids Nutrient Management Matrix (below) provides best available guidance for the management of biosolids applications, providing a clear, simple and self-limiting system to manage P inputs over crop rotations. The Matrix should be used to complement, and not replace, nutrient management planning for both nitrogen and phosphate on farms where biosolids are used.

Biosolids Nutrient Management Matrix

ADAS soil P Index	Maximum potential application of *lime treated* biosolids [a]	Maximum potential application of *all* other biosolids types
0/1/2	250 kg/ha total N in any twelve month period	250 kg/ha total N in any twelve month period
3	250 kg/ha total N in any twelve month period – application 1 year in 4 on sandy soils and 1 year in 2 on all other soils	250 kg/ha total N in any twelve month period – application 1 year in 2 on sandy soils [b]
4	250 kg/ha total N in any twelve month period – application 1 year in 5 on sandy soils and 1 year in 3 on all other soils	250 kg/ha total N in any twelve month period – application 1 year in 4 on sandy soils [c] and 1 year in 3 on all other soils (see note below)
5 and above	No application	No application

[a] Lime addition rate >5% w/w on a dry solids basis

[b] Composted biosolids can be applied annually and [c] can be applied 1 year in 2

Notes:

- Soil extractable P analysis must be less than 5 years old (0-15cm soil sampling depth on arable land; 0-7.5cm on grassland).
- Soil types based on Cross Compliance soil categories.
- No biosolids applications directly in front of legumes (e.g. peas, beans), except for composted biosolids which is very low in readily available N.
- Septic tank sludge is not included within the scope of the Matrix.

December 2019

From 1st January 2021, the maximum potential application of *all* other biosolids types applied to ADAS soil P Index 4 soils will be 250 kg/ha total N in any twelve month period – application 1 year in 4 on sandy soils [c] and 1 year in 3 on all other soils. This was previously (up until 1st January 2021) 1 year in 2.

25. Soil P methods in England & Wales and Scotland

The reference method for assessing soil P is *Olsen's P method* for soils in England and Wales (AHDB, RB209) and often expressed as *ADAS soil P Index*. Whereas for soils in Scotland it is the *SAC Modified Morgan's method* expressed in bands from very low (VL) to very high (VH).

Situations can occur where soil samples from different regions are analysed in the same laboratory using the same soil P method, which can lead to apparent discrepancies on nutrient planning. The following 'look up table' enables BAS Applicants and Members to demonstrate that the soil P analysis they hold can be related to the Standard requirements for the region where the sample was taken.

SAC Status (ADAS Index)	**Extractable Phosphorus (mg/l)**	
	SAC[1]	**RB209[2]**
VL (Index 0)	0 – 1.7	0 – 9
L (Index 1)	1.8 – 4.4	10 – 15
M- (Index 2)	4.5 – 9.4	16 – 20
M+ (Index 2)	9.5 – 13.4	21 – 25
H (Index 3)	13.5 – 30	26 – 45
VH (≥Index 4)	>30	>45

[1] SAC Modified Morgan's method

[2] Olsen's P method

Taken from SAC Technical Note (TN) 633

26. Low rate/high frequency biosolids applications

The Biosolids Nutrient Management Matrix (BNMM) applicable in England and Wales, depending on the soil P status and soil type, restricts the frequency of applications between annual (i.e. 1 application in 1 year) to 1 application in 4 years (or no application on high Index soils) with an application rate limited to 250 kg N per hectare. However, there are certain situations and crops, for example turf production, whereby applications of much less than 250 kg N per hectare are required. In this situation multiple individual applications can be made providing the total amount does not exceed 250 kg N per hectare across the frequency allowable as detailed in the BNMM.

For example an application to turf production which requires 50 kg N per hectare and is on a sandy soil with a P index of 4 would be restricted to 1 in 4 years under the BNMM. Annual applications of 50 kg N per hectare for each of the 4 years would be allowable given the total quantity of nitrogen would be 200 kg N per hectare – i.e. within the limit of 250 kg N per hectare.

It is recommended that a FACTS qualified advisor provides a written advisory note to support the proposed applications and to provide justification in the case of enquires from an auditor or a Regulator.

27. FACTS Qualification

From 1st June 2021 the BAS Standard requires complex nutrient advice/assessments to be made by a Fertiliser Advisers Certification and Training Scheme (FACTS) qualified individual, rather than someone FACTS trained. However, this requirement only relates to complex nutrient advice. Examples of this include going beyond the recommendations in RB209 or using biosolids at high/very high soil P indices in Scotland. This does not necessarily apply to the person passing on the advice, but relates to the individual actually formulating the advice or making the assessment. For example, 'normal' interactions with farming customers around biosolids use, the nutrient content of biosolids, siting of stockpiles, undertaking field risk assessments or passing on complex advice do not have be undertaken by a FACTS qualified (or trained) individual.

28. Communication between Members in a Chain of Conformity

Before biosolids can be deemed to be 'BAS Certified Biosolids, all three processes covering the full scope of the BAS must be certified (i.e. maintain a valid Certificate of Conformity), to complete a Chain of Conformity. For BAS Applicants or Members who undertake only one or two elements, this can add complexity as information needs to be passed between the different parts of the chain to allow subsequent (or even preceding sections) to be certified.

As the first step in the chain is treatment, the BAS Member who has certification (or the Applicant who wishes to gain certification) for treatment, is required to provide the most information to other parties in the chain.

28.1 Routine MAC sampling

When a HACCP plan has been produced and the treatment process validated, assuming the process is operated in conformance with the Critical Limits (CLs) set in the HACCP plan, the biosolids should meet the required quality (i.e. either the conventional or enhanced treatment standard). To demonstrate the process is still operating correctly and to ensure the biosolids is conformant, treated sludge (biosolids) must to be sampled at least quarterly and the results compared to the Maximum Allowable Concentration (MAC) for the relevant treatment standard.

However, when a MAC sample has been taken the sampled biosolids and any subsequently produced biosolids must not be applied to land until the analysis result has been received and confirms it complies with the relevant MAC limit (note material can still be taken to permanent or temporary field storage during this period). Therefore, the treatment operator must inform the other parties in the chain when a MAC sample has been taken so they can 'hold' the biosolids and ensure it is not applied to agricultural land. Confirmation should be requested from the relevant party(s) in the chain to ensure they have received the 'hold' request and acted upon it. This email exchange could then act as evidence to the auditor that the treatment operator is in control of the activities and are ensuring they are meeting their obligations as required by the BAS Standard.

28.2 Critical limit or plant failure

If during the 'normal' operation of the treatment process there has been a process deviation of a Critical Limit (as set in the site's HACCP plan) that is likely to have a negative impact on biosolids conformity, then the potentially non-conforming material must be sampled to determine if it meets the relevant MAC. Similarly, if there is a plant failure that is likely to have a negative impact on biosolids conformity, then the potentially non-conforming material must be sampled to determine if it meets the relevant MAC.

In these instances, the treatment operator must inform the other parties in the chain that there has been a deviation in the process or plant failure and a MAC sample has been taken. Therefore, all potentially non-conforming material must be held and not applied to agricultural land but can still be stored in permanent storage or in temporary field storage awaiting the outcome of the analytical results. Confirmation should be requested from the relevant party(s) in the chain to ensure they have received the 'hold' request and acted upon it. This email exchange could then act as evidence to the auditor that the treatment operator is in control of the activities and are ensuring they are meeting their obligations as required by the BAS Standard.

28.3 MAC testing results

When the treatment operator receives the results from the laboratory on the MAC sample(s), assuming the results comply with the relevant limit, the permission to 'release' any 'held' material should be communicated to the other parties in the chain.

If the analysis result does not comply with the relevant limit, the sampled material and any subsequently produced material must be quarantined.

28.4 Quarantine procedure

If a routine MAC test or a MAC test where there has been a deviation during treatment fails to meet the relevant treatment standard, the sampled material and any subsequently produced material must be quarantined. Having a quarantine procedure and ensuring it is followed is the responsibility of the treatment operator, even if the actual quarantining is undertaken by a 3rd party. This is because they are the organisation who are responsible for the treatment and who would be aware (in the unlikely event) that something has gone wrong either in the treatment process or with an analytical result (i.e. a MAC test).

In this situation the treatment operator must inform the other parties in the chain that there has been a MAC test failure. Therefore, all non-conforming and subsequently produced material must be identified as quarantined and the appropriate quarantine procedure and the BAS Standard must be followed. Confirmation should be requested from the relevant party(s) in the chain to ensure they have received the quarantine notification and acted upon it. This email exchange could then act as evidence to the auditor that the treatment operator is in control of the activities and are ensuring they are meeting their obligations as required by the BAS Standard.

29. Glossary

Agricultural land	Includes horticulture, fruit growing, seed growing, commercial food crop growing, including for stock-rearing purposes, dairy farming and livestock breeding and keeping, the use of land as grazing land, meadow land, industrially cropped land, market gardens and nursery grounds, and for woodlands where that use is ancillary to the farming of land for other agricultural purposes.
Batch processing	A process that treats a specific quantity of sludge at one time and produces a specific quantity of treated sludge (biosolids). Examples of batch processes are composting, cake storage or lime treatment (where a specific quantity of sludge is lime treated at one time). For processes that are part continuous and followed by part batch (e.g. continuous digestion followed by cake storage in batch), the overall process can be deemed as batch processing.
Biosolids	See Treated sludge.
Certification Body	Organisations appointed by ABL to assess an organisation's conformance to the requirements of the BAS.
Certified biosolids	Biosolids that have been treated and recycled by a single organisation or multiple organisations that have been issued with a Certificate(s) of Conformity for the full scope of the BAS (i.e. treatment, transport & storage and recycling).
Certificate of Conformity	The document issued by the Certification Body verifying conformity with the BAS Standard for the elected scope of activities.
Continuous processing	A process which treats untreated sludge constantly to produce a constant stream of treated sludge (biosolids). Examples of continuous processes are anaerobic digestion or lime treatment (where lime is dosed into a pipe or dewatering equipment). If a continuous process is followed by a batch process (e.g. anaerobic digestion followed by cake storage in a batch) the overall process could be deemed as batch processing.
Conventionally treated	Biosolids with a MAC of 100,000 *E. coli* per g dry solids (also referred to as 10^5).
Corrective action	Action taken to remedy deviations from HACCP Critical Limits and other requirements in the Standard.
Curtilage	Land adjacent to a sludge treatment centre managed by the Processing Facility.
Duty of care	A legal obligation where the organisation must take responsibility for providing services to a reasonable standard of care.
Enhanced treated	Biosolids with a MAC of 1,000 *E. coli* per g dry solids (also referred to as 10^3) and the absence of S*almonella spp*.

Effective field drain	A field drain that is in working order and will be functional under suitable conditions
Lime stabilised	Lime stabilisation is the reduction in % liquid in the sludge/biosolids by the addition of quick lime (CaOH), which has the effect of making the biosolids more able to form a freestanding heap. This does not necessarily form part of a HACCP validated treatment process.
Lime treated	Lime treatment is a recognised effective sludge treatment process that will reduce the microbiological parameters in the sludge to create biosolids via a HACCP validated process. Acceptable lime mixing methods are mechanically/electronically controlled processes that once set-up will repeat the process without human interaction/control (e.g. lime addition during/prior to dewatering, mixing screws or plough shares).
Log reduction	The extent of microbiological parameter destruction during the sludge treatment process. For example, a 2-log *E. coli* reduction is 100-fold lower than the original value.
Monthly and quarterly (for sampling)	In respect of sampling, monthly means within 30 days (or the length of the relevant month) of the previous sample and quarterly means within 90 days (or the length of the relevant quarter) of the previous sample.
Permanent biosolids storage	Biosolids storage facilities that are not within the curtilage of the Processing Facility and are intended for continuous use.
Portable plant	Treatment equipment (usually for lime treatment) that regularly moves to new sites, particularly where the sludge moves to the site for treatment (often as a contingency activity), and at fixed sites where the (portable) plant may only be brought to the site when required (often as a contingency activity).
Quarantined sludge	The physical isolation of sludge by separate storage from other treated sludge for treated sludge that has failed a routine schedule sample or for a deviation outside HACCP critical limits or a plant failure, the potentially non-conforming material must be quarantined, where it is destined for recycling to agricultural land.
Reference Processing Facility	Sites where sludge and other materials are treated or processed.
Sludge	Untreated sludge produced from wastewater treatment processes and any other source materials that enter the process.
Sludge treatment centre (STC)	Reference Processing Facility where untreated sludge is treated to a prescribed standard to produce biosolids.

Temporary biosolids field storage	Short term biosolids field storage at the place where they are to be used.
Treated sludge	Sludge and any other source materials that enter the process that has been treated by a HACCP validated biological, chemical or heat treatment, or any other appropriate process, as described in the Standard Guidance Notes, that significantly reduces its fermentability and potential health hazards resulting from its use in agriculture. Also known as treated sewage sludge or biosolids.
Untreated (raw) sludge	Sludge and any other source materials that enter the process that have not been through a sludge treatment process and are still in their raw state. They may have been through other processes (e.g. wastewater treatment) but have not been through a process designed to reduce their microbial properties (as described in section 5a).
Untreated (non-validated) sludge	Sludge and any other source materials that enter the process that have been through a treatment process but have not qualified as either Conventional or Enhanced treated biosolids (e.g. that have been treated in a non-validated process or a non-conforming process).
Validation	The period of intense sampling and analysis to demonstrate a treatment process can achieve the specified log reduction and produce biosolids of the required standard.
Verification	Confirmation of compliance with all the elements of the HACCP plan.
Wastewater	Wastewater from domestic premises and/or industrial wastewater and/or run-off rainwater.
Wastewater treatment works (WwTW)	Processing Facilities used to treat sewage (wastewater) where the effluent is returned to a water course and untreated sludge is collected.

30. Abbreviations

CCP	Critical Control Point –a step in a process where a specified hazard can be eliminated or minimised to an acceptable level
Cfu/g	Colony forming units per gram
CL	Critical Limit – a specific value that determines acceptable limits at Critical Control Points
CoGAP	Code of Good Agricultural Practice
COP	Code of Practice
Defra	Department for Environment, Food and Rural Affairs
DS	Dry solids
E. coli	*Escherichia coli*
EA	Environment Agency
GW SPZ	Groundwater Source Protection Zone
HACCP	Hazard analysis critical control point – a food industry-based system for identifying, assessing and controlling potential hazards
MAC	Maximum allowable concentration
N	Nitrogen
NVZ	Nitrate Vulnerable Zone
NRW	Natural Resources Wales
P	Phosphorus
P_2O_5	Phosphate. Can be calculated as P x 2.215
PTE	Potentially toxic element
Salmonella spp.	*Salmonella* species
SEPA	Scottish Environment Protection Agency
SSM	Safe Sludge Matrix
STC	Sludge Treatment Centre
UKAS	United Kingdom Accreditation Service
UKWIR	United Kingdom Water Industry Research
WwTW	Wastewater treatment works

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