Slurry storage requirements and design for Whitchurch Farm

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ADAS GENERAL NOTES

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1. INTRODUCTION

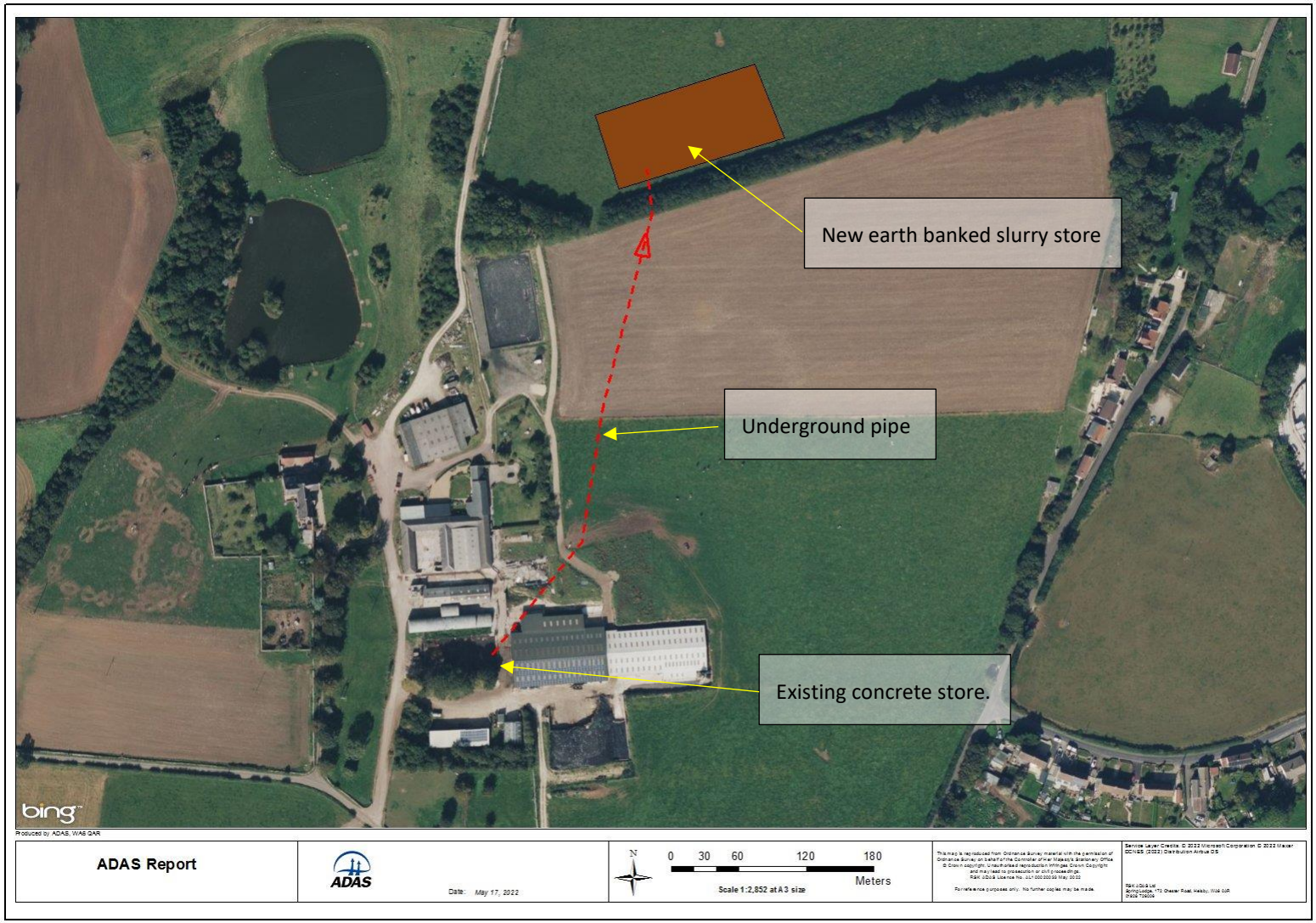
This report is a calculation of the slurry storage capacity required for a new earth-banked store at the farm. Whitchurch Farm is an owner-occupied dairy unit with 220 milking cattle, young stock are housed at a separate location. The farm is located within a Nitrate Vulnerable Zone and SSSI Impact Risk Zones.

The farm intends to use the existing concrete store as a reception pit and construct a clay lined satellite store. All calculations are based on six months storage capacity, which will ensure the site has enough storage to meet SSAFO (four months), NVZ (five months), and Environment Agency's (EA) recommendations.

The EA are now strongly recommending that all farms (both in and outside NVZs) should provide 6 months slurry storage to ensure they can comply with the Farming Rules for Water(FRfW).

For all existing slurry stores at the farm, and when designing any new slurry stores in the future, consideration must be given as to how these structures could be covered to reduce ammonia emissions. The report includes drawings for the proposed slurry storage system.

2. PROPOSED SITE PLAN AT WHITCHURCH FARM



3. SLURRY STORAGE CALCULATION

All measurements stated should be taken as approximate. Any figures quoted are based on information provided during the site visit and have not been confirmed by direct measurements.

The calculations below outline the theoretical output of slurry, parlour washings and volumes of fouled yard runoff expected to arise on the unit.

Calculations are based on a minimum of 6 months slurry production based on NVZ standard figures. Rainfall figures are derived from the AHDB slurry Wizard, with annual rainfall taken to be 1104mm, and the worst 5 months rainfall in 5 years (M5 150 day) of 680mm. An additional month's rainfall (94mm) has been added to account for the six-month storage period.

Table 1: Rainfall

Rainfall over 6 months (mm)
774mm

Table 2: Slurry production

Livestock type on slurry or part-slurry based system	Livestock numbers	Volume per livestock unit m^3	Output per average month m^3	6-month storage volume (m^3)
1 dairy cow after first calf (6,000 to 9,000 litres milk yield)	220	1.59	350	**2,100**
1 dairy cow from 12 months up to first calf	50	1.2	60	**360**
Parlour washings	220	0.9	198	**1,188**
Silage clamps and open yards	1,900m^2 (774mm)			**1,470**
			Total (6 Months)	**5,118**

(*If any of the figures change you should adjust the calculations)*

All lightly fouled water generated on the farm will be diverted to the slurry storage system. This includes parlour washings and runoff generated by the silage clamps.

For your information, if lightly fouled water is stored separately from slurry, it can be spread legally throughout the year in an NVZ, provided it can be carried out without risk of pollution or exceeding the crop's N requirement. All spreading should be carried out in accordance with COGAP guidelines.

Table 3: Slurry storage capacity

Storage Capacity	Storage m³
Existing concrete store. 1.82 x 795m² The 300mm statutory freeboard and a deduction for rainfall of 774mm has been included in the calculation.	590
Total Storage Capacity	**590**

Table 4: Current storage capacity v required capacity

Total Storage Available	Storage Required	Storage shortfall
590m³	5,118m³	4,528m³

4. SLURRY STORE SIZE

The business intends to construct a slurry store with approximately 4,600m³ of storage capacity. This will ensure the farm has sufficient capacity to comply with SSAFO and NVZ storage requirements and reduce the risk of pollution, as the farm will avoid the need to spread during inappropriate weather conditions.

It is understood clay will be imported to line the earth banked store. You will need to carry out soil testing in accordance with the protocol laid out in CIRIA 759, Any imported clay used to construct the lagoon should be tested in a recognised laboratory.

https://www.ciria.org/Resources/Free_publications/Farms.aspx

Table 5: Acceptance criteria for soil.

Characteristic	Acceptance limit
Minimum clay content[1]	20%[2]
Liquid limit	Not to exceed 90[3]
Plasticity index	Not to exceed 65[3]
Permeability	Not to exceed 10^{-9} m/s

Notes

1 Less than 0.002 mm particle size.
2 Less than 20 per cent clay content would require particular attention to the formation and compaction of the embankments and floor of the structure. The use of a liner maybe a required option.
3 Dimensionless.

You should discuss all aspects of the lagoon construction with the EA, and you will need to consult the relevant planning authority. A structural engineer should be employed to assist with designs. We recommend an experienced contractor is used for the project. The lagoon should be inspected and maintained to reduce the risk of pollution to ground and surface water. You must notify the EA at least 14 days before you commence construction of new storage for silage, slurry or agricultural fuel oil, or make substantial changes to an existing store. Slurry tanks, reception pits, pipes and channels must be impermeable and meet the anti-corrosion standards set in British Standard 5502-50:1993+A2:2010. They should last for at least 20 years with maintenance.

A lagoon of approx. 4,600m³ is recommended as this will provide 6 months storage capacity for the farm. A slurry store with a capacity of 4,600m³ will require an excavation 65m wide x 30m long x 6.5m deep, with an internal bank slope of 1:1.5 for the earth banks. The lagoon capacity takes into account the rainfall and freeboard requirement. All earth banked lagoons require a freeboard of 750mm plus the ability to contain any surface rainfall which would be a minimum of 774mm for the 6-month storage requirements.

Any land drains encountered during the construction should be traced and stripped out where they run within 10m of the excavation, and the resultant trench backfilled with compacted clay. Any functional drains to be re-routed at least 10m from the site.

An engineer should be consulted over the detail of the approach to construction. The lagoon base needs to have at least 1m depth of machine compacted clay soil, the same material used for the lagoon sides, and therefore the initial excavations will need to be 1 m greater than the final lagoon depth.

The interior of the excavation should be sealed by placing and re-working the clay using the machine bucket, tracking it in and compacting with a suitable roller. Tracking in using the excavator alone will not achieve a sufficient degree of compaction.

The topsoil should be replaced over the excavated subsoil on the surrounding area up to the edge of the lagoon, before the safety fence is erected. The perimeter of the excavation should be fenced to HSE standards to prevent unauthorised access, fence to be at least 1.3m minimum high topped with barbed wire, or otherwise unclimbable, with meshed or sheeted gates at the access point.

Slurry will be pumped from the existing concrete store to the new lagoon through an underground pipe over approximately 250 metres. A pipe of no less than 6 inches (152mm) diameter capable of withstanding the pressures developed by the proposed pumping system will be required and the discharge point into the lagoon should have scour protection to prevent erosion of the clay lining. Due to the land levels the store cannot be gravity fed, therefore, all slurry will need to be pumped across and over the new bank top and into the new lagoon.

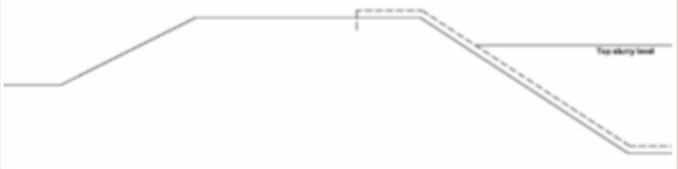
5. LEAK DETECTION SYSTEM

The EA may require a leak detection system for new slurry lagoons and the installation requirements would need to be agreed before construction begins.

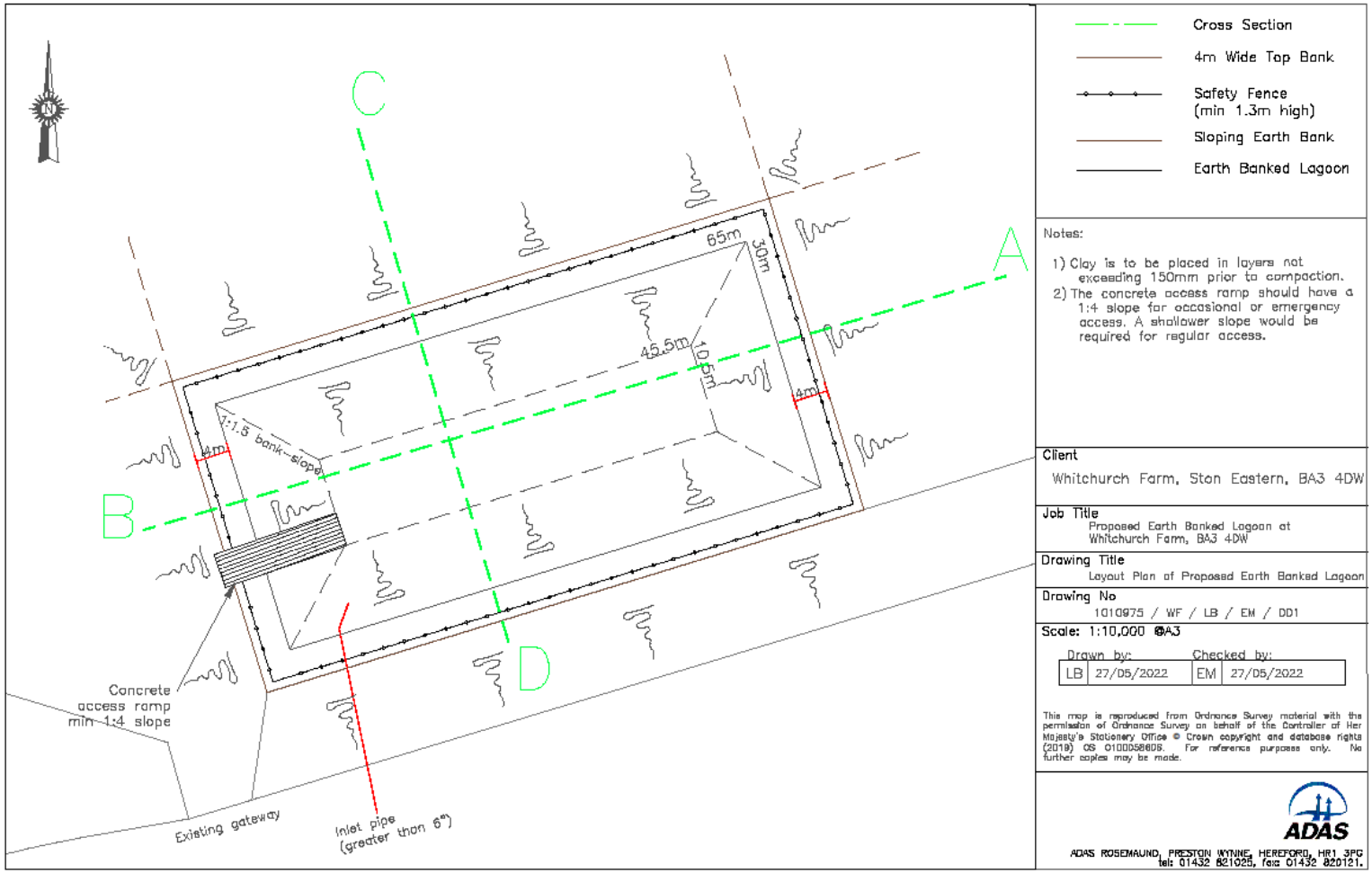
The requirement for a leak detection system and the extent of the system should be based on the findings of the site investigation and risk assessment. The leak detection system should be installed between two impermeable layers. This allows the bottom layer to act as a secondary barrier to prevent leaks. A plastic pipe system under the structure can be used. Liquid can drain to an inspection chamber beyond the perimeter of the structure where any flow can be monitored.

The leak detection system can follow a herringbone formation where liquid is drained to the inspection chamber. 100mm perforated plastic pipe can be used for the system. This could be placed between two layers of clay for the proposed lagoon.

Table 6: Example of selection criteria for leak detection system.

 a) Single-skin liner without leak detection	Ground with natural permeability < 10^{-9} to 10^{-8} m/s over a minimum 1 m thick stratum.
 b) Single-skin liner with leak detection	Ground with natural permeability < 10^{-8} to 10^{-7} m/s over a minimum 1 m thick stratum.
 c) Double-skin liner with leak detection	Ground with natural permeability < 10^{-7} m/s over a minimum 1 m thick stratum.

APPENDIX 1: SITE LAYOUT PLAN



APPENDIX 2: CROSS SECTION PLAN