J840 – STC IED Containment

Oxford STW – Containment Options Report

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Thames Water

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1.0	23/09/2022	First Issue	WS	SMNS	SC	HG
2.0	30/03/2023	Updated to include THP Area Containment	KG	SMNS	SC	HG
3.0	12/07/2023	Updated to include revised IED boundary plan and Containment Area 8	KG	SMNS	SC	HG
4.0	16/11/2023	Updated following EA RFI	KG	SMNS	SC	HG

Contents

1. Executive Summary

Thames Water is required by the Environment Agency to provide secondary containment to their sludge treatment centres (STC) to satisfy provisions of the Industrial Emissions Directive and to safeguard the operation of the adjacent sewage treatments works. Twenty-five sludge treatment centres have been identified where containment proposals are required. This report deals with the proposals for Oxford.

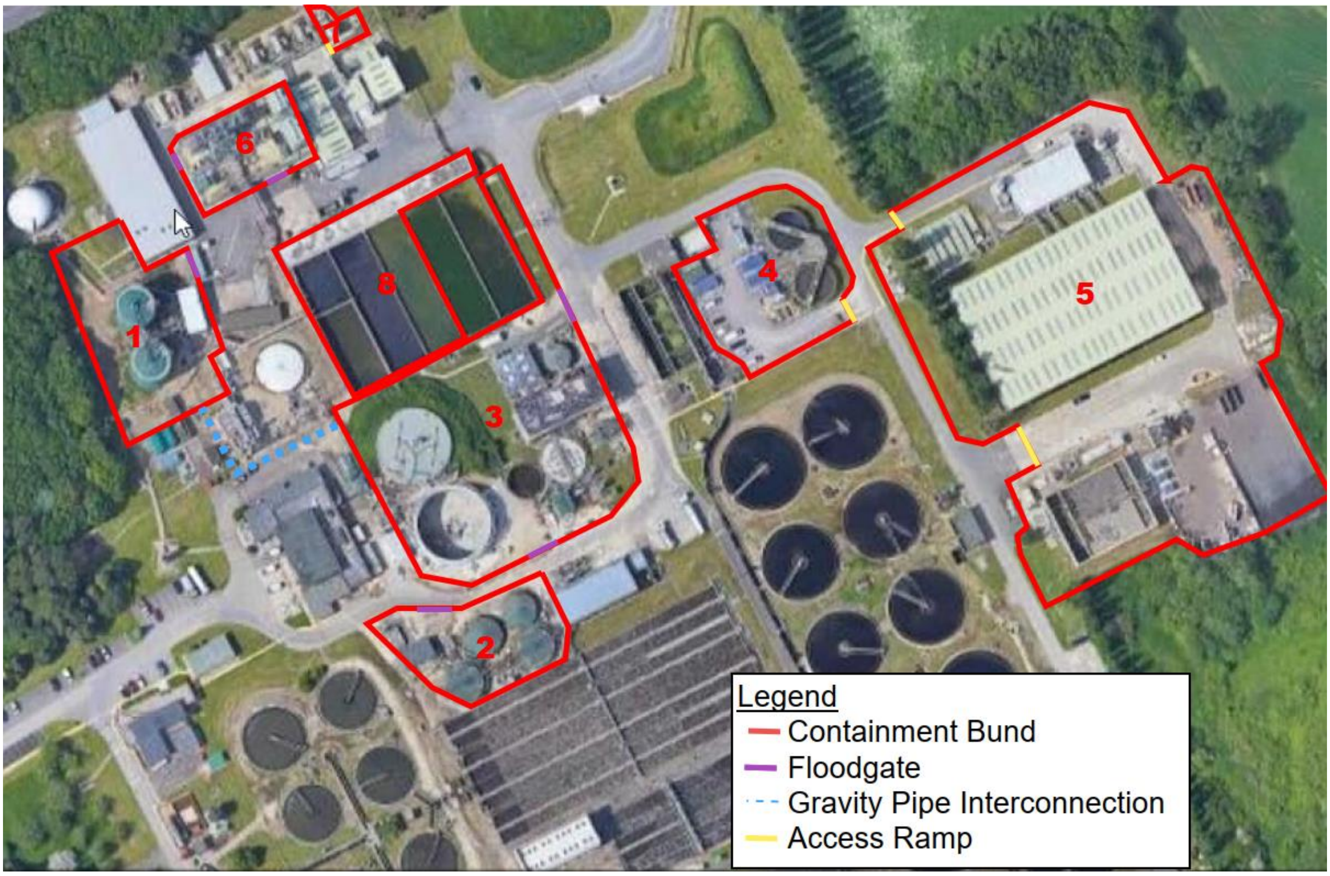
CIRIA Report 736 – Containment systems for the prevention of pollution sets out principles and direction. This report sets out options to apply the CIRIA 736 principles within the accepted constraints of a retrofitted solution.

Oxford Sewage Treatment Works (STW) is located near Sandford-On-Thames and is surrounded by residential, industrial, and commercial works. These include the Oxford Science Park and sport recreational facilities like Oxford United Football Club. The STW serves a population equivalent of 250,000, serving the city of Oxford and its surrounding villages. The overall site risk rating was calculated using the ABDA Risk Assessment Tool and determined to be medium which means that Class 2 secondary containment is required.

This assessment focuses on the provision of the secondary containment and outlines the options. The nature of the site allows the tanks to be grouped and addressed separately (provided the gravity line is manually isolated between the interconnected areas 1 & 3). The aggregate total critical spill volume for the Oxford site is 8722m^3.

One option was developed in detail for sludge containment at Oxford STW – eight close individual containment areas, including an interconnection between Area 1 and 3 and modifications to the existing tank in Area 8 to provide containment. The bunded containment areas (Areas 1 to 7) will have a bund wall maximum height of 1.25m (inc. freeboard) in Area 2 with walls under 1m for the remainder. Areas 1&3, 2 and 6 will require floodgates for entry. The floodgates will be normally-closed and alarmed via SCADA to indicate when they are not-closed. Entry in Area 4, 5 and 7 will be via access ramps, which is possible due to the containment depth being under 0.3m. In addition to the containment elements, the ability to isolate site drainage connection system will be required to mitigate the risk of unmanaged flows impacting the sewage treatment works and prevent spills entering the waterway. Replacement of permeable surfaces will minimise clean-up time and effort. Freeboard allowances and the profile of the containment bund wall provides mitigation against surge effects. Jetting escape is a risk for this site due to space constraints.

General layout of the proposed solution:


1
2
3
4
5
6
7
8
Legend
Containment Bund
Floodgate
Gravity Pipe Interconnection
Access Ramp

2. Background

Following initial audits by the Environment Agency (EA) in 2019 that examined the primary, secondary, and tertiary containment provisions for Thames Water's anaerobic digestion (AD) process and associated tanks, the EA reported "there is no provision of secondary containment for the AD process at any of Thames Water's sites. Catastrophic tank failure may impact nearby receptors and the operation of adjacent sewage treatment activities". Jacobs were appointed to assess site risks and outline the options available for providing secondary containment of a catastrophic tank or digester failure across 25 Thames Water sites. Based on CIRIA C736 and ADBA risk assessment tools, this containment report addresses the site-specific risks and outlines the options available for providing secondary containment in the event of a catastrophic tank or digester failure.

The current assessment identified gaps between the existing condition of the sludge assets in Oxford STW and the requirements to meet the industrial standard (i.e., CIRIA C736 and The Anaerobic Digestion and Bioresources Association Limited (ADBA) risk assessment tool). Site-specific risks, credible failure scenario and design containment volume for the Oxford STW were identified through a desktop study, Light Detection and Ranging (LiDAR) analysis and a site visit.

Oxford STW (Figure 2-1) below, is located near Sandford-On-Thames, surrounded by residential, industrial, and commercial works. These include the Oxford Science Park and sport recreational facilities like Oxford United Football Club. The STW serves a population equivalent of 250,000, serving the city of Oxford and its surrounding villages.

Figure 2-1- Satellite view of Oxford Sewage Treatment Works

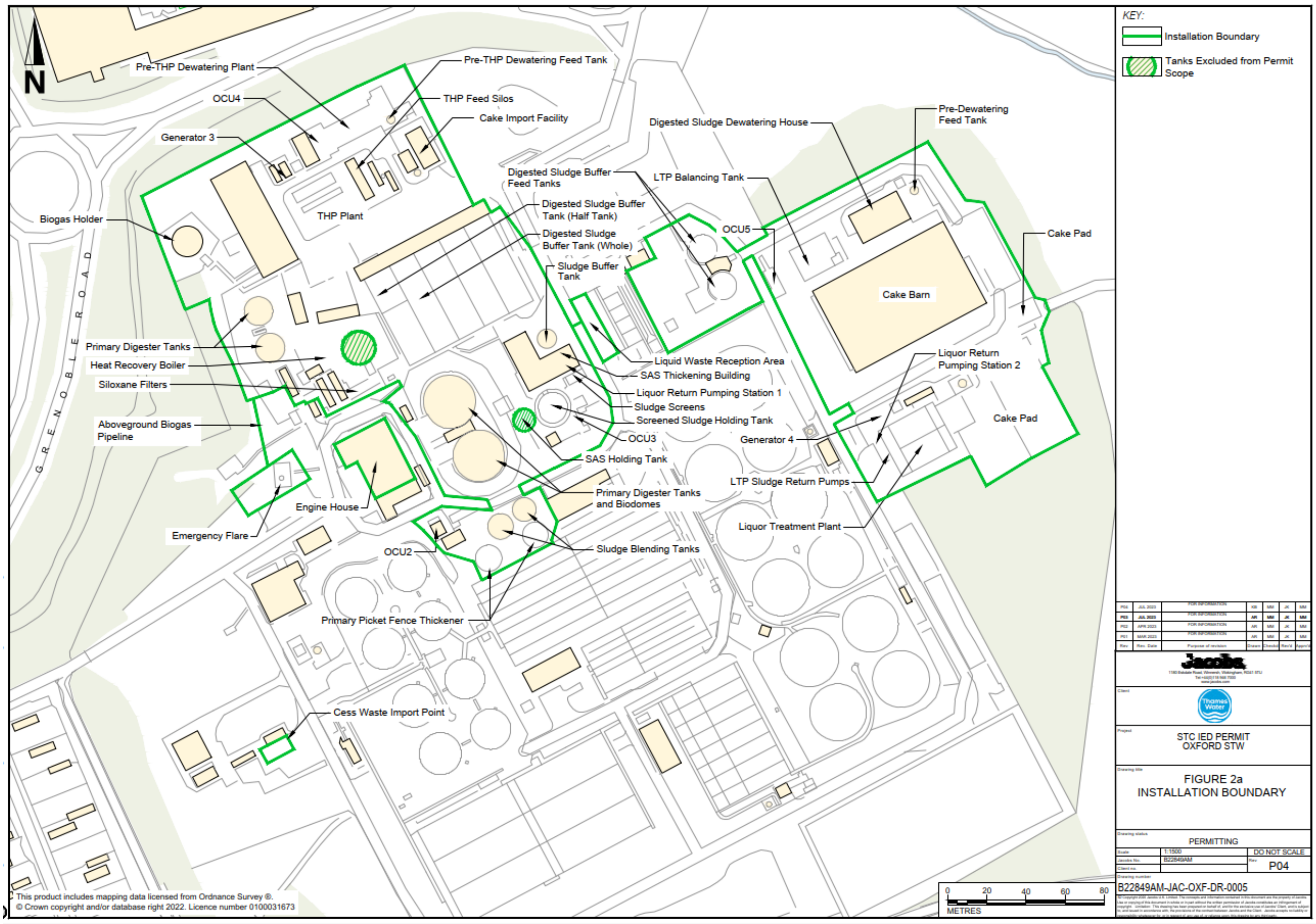


Figure 2-2 - Boundary of the permitted IED area and the assets contained within Oxford STW

This document should be read in conjunction with Oxford STW, Risk Identification and Containment Assessment Report, revision OA dated 25/04/2022. This report outlines the impact of an uncontained spill and the risk assessment completed.

3. Proposed Containment at Oxford STW

3.1 CIRIA C736

This containment option report has been prepared using CIRIA C736 as the basis of design and guidelines. Where a deviation from C736 has been recommended it is highlighted in the text.

CIRIA guidance document C736 *(Containment systems for the prevention of pollution – Secondary, tertiary, and other measures for industrial and commercial premises, 2014)* describes various options for containment of spillages from a credible failure scenario. It makes reference to a key plan, reproduced in Figure 3-1 below;

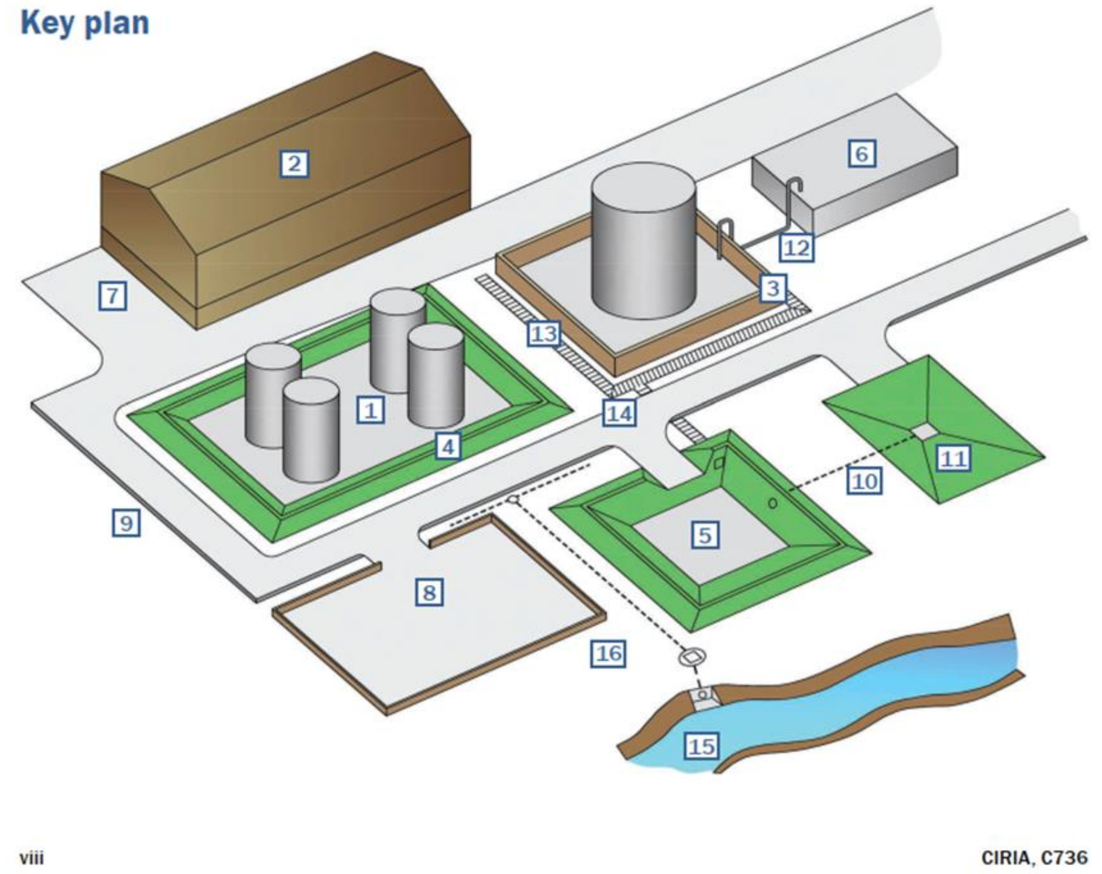


Figure 3-1 - Diagram of primary, secondary and tertiary containment examples (Figure 3.3. in CIRIA 736)

-**Primary containment** is provided by the actual tank or vessel [1]

-**Secondary containment** is provided by a bund immediately surrounding the primary vessel e.g. [3] and [4], or by a lagoon [5] or tank [6]. If containment is provided away from the primary vessels this is known as **remote containment** and may be considered as either **remote secondary** or **tertiary containment**.

-**Tertiary containment** can be provided by a number of means including lagoons [5], or impermeable areas such car parks [8]. Roadways with high kerbing of sufficient height [9] can also form part of a tertiary containment system, or the **transfer system** to the remote containment.

The distinction between *remote secondary* and *tertiary* containment is not always clear but, if properly designed, a combined system can be provided that is capable of providing the necessary degree of environmental protection. The overriding concern is not the terminology but the robustness and reliability of the system which depends on a number of factors such as;

- Its complexity – the more there is to go wrong, the greater the risk. Passive systems relying solely on gravity are more reliable than pumped.
- Whether manual intervention is relied on to make the system work or whether the system can be automated to include fail-safes and interlocks.
- The ease of maintenance and monitoring of the system's integrity, and repair of any defects.

During and after an incident any rainfall runoff from the secondary storage areas, from the spillage catchment areas and from the transfer systems must also be prevented from reaching any outfall(s) to surface water by closure of control valve(s).

3.2 Objectives of secondary containment

The objectives of the secondary containment measures proposed in this report are to safely contain spillages from credible failure scenarios and prevent them from:

- escaping off site
- entering surface waters
- percolating into groundwater
- being discharged to the inlet of the sewage works in an uncontrolled manner.

As the project is retrofitting the provisions of CIRIA 736 to an existing facility, the secondary containment may seek to maximise the use of existing impermeable surfaced areas.

The interface between the contained area and existing process/site drainage return systems is managed to protect the sewage treatment works from shock loads that might otherwise arise from a tank failure.

3.2.1 Uncontained Spill modelling

Figure 3-2 shows the sludge spill mapping of an uncontained event in Oxford STW, indicating that a potential sludge spill from one of the steel digesters will not be self-contained within the site and therefore passive containment needs to be implemented to safeguard the nearby receptors. The model result shows the spill will leave the site boundary (in the northeast site boundary) in approximately 13 minutes after the failure of one of the digesters.

Assuming the spilled sludge originates from the failure of one of the steel Primary Digesters on site, the bulk of the sludge travels northeast breaching the boundary and travelling towards Littlemore Brook and contaminating the watercourse. The uncontained release would travel north then westward affecting Grenoble Road and roundabout with Robert Robinson Avenue to the northeast which is the connecting road for businesses in the commercial estate to the north, Oxford Science Park and Kassam Stadium to the northeast. Traveling along Grenoble Road it then forked southeast from the road in the direction of an unnamed stream that joins Littlemore Brook. Some sludge travel northward along an unnamed access road leading to the back entrance of the Hampton Hotel. Within the STW, the uncontained release would surround various equipment such as an emergency generator, Pre-THP Dewatering Plant, Boilers, Sludge Cake Reception Area and the THP Feed Silo.

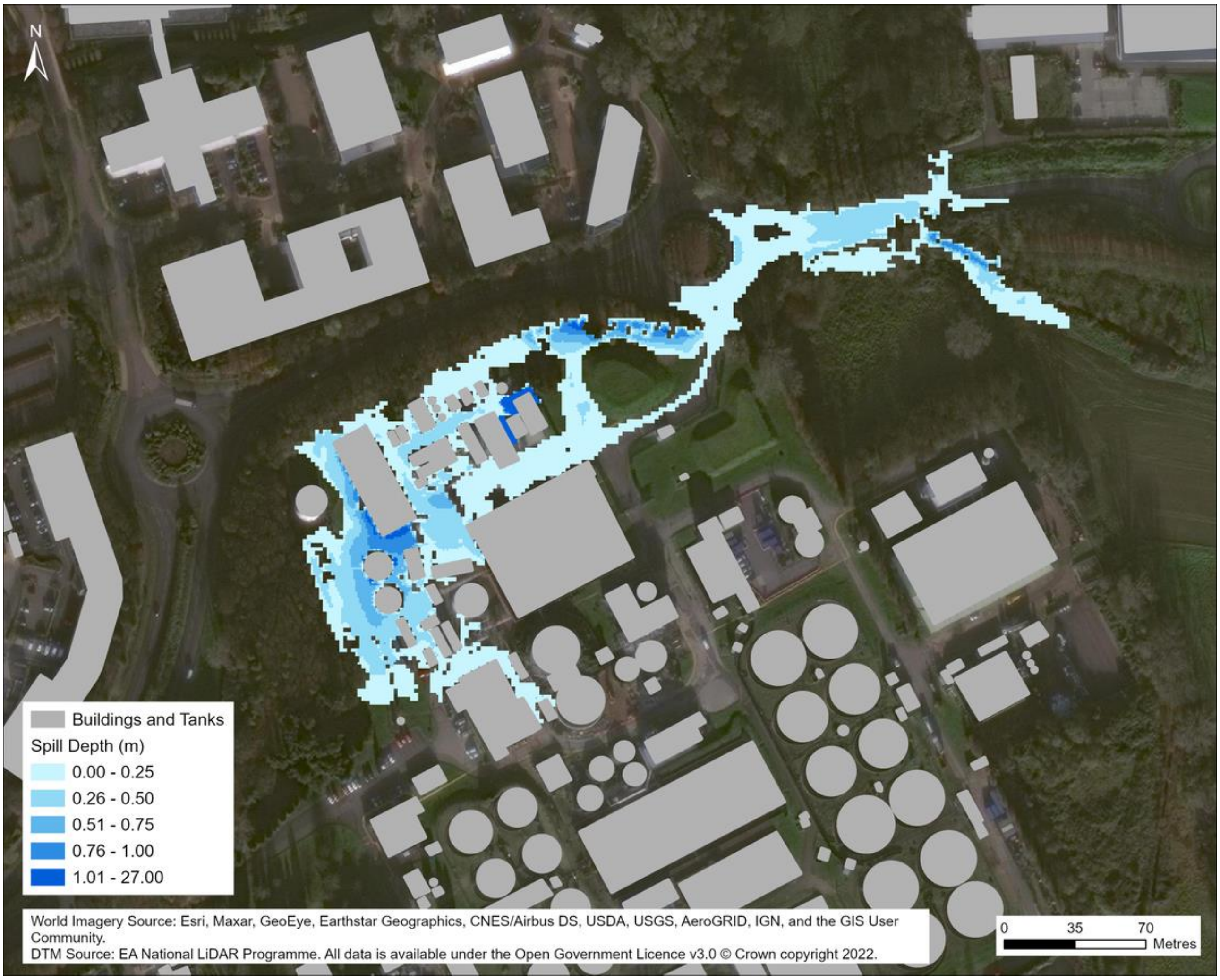


Figure 3-2 - Uncontained Spill Model Results

3.3 Site Classification

Based on the use of the ADBA risk assessment, considering the source, pathway and receptor risk Oxford site hazard rating is deemed to be Medium. When considering the mitigated likelihood as low a class 2 secondary containment is required.

Source Risk	Pathway Risk	Receptor Risk	Site Hazard Rating	Likelihood	Overall Site Risk Rating
High	**Medium**	**Medium**	**High**	**Low**	**Medium (Class 2)**

Refer to Appendix 1 for more detailed summary of the ADBA risk assessment tool.

3.4 Summary of Containment Volumes and Assets

There are 28 tanks in total containing sludge (or sludge related liquors), constructed with steel or concrete, with a total operational volume of approximately 18402m^3. All of which will require containment in accordance with CIRIA. The assets are shown on the annotated map in Figure 3-3.

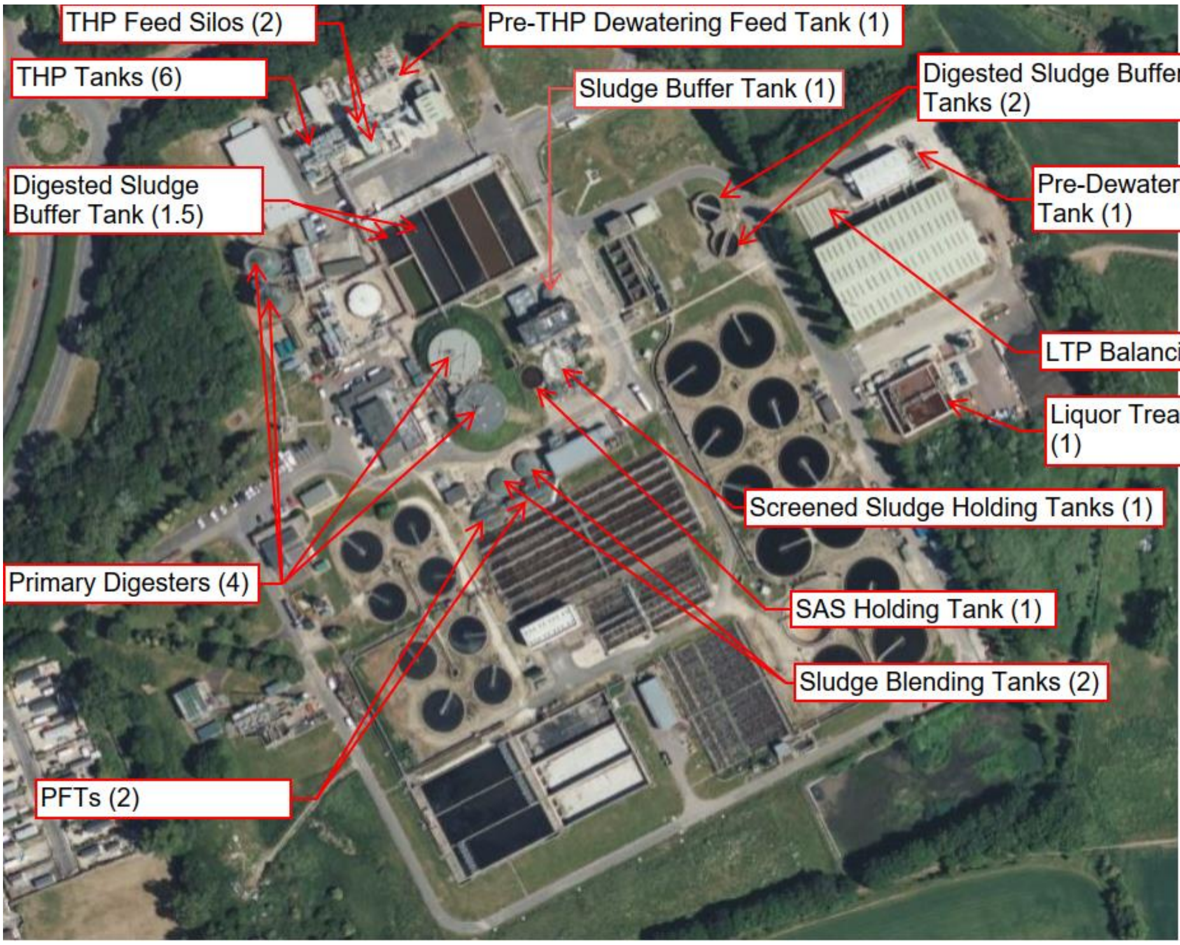


Figure 3-3 - Oxford Sludge Asset Map

The principal sludge holding and digestion tanks at Oxford contained within the IED permitted area are detailed in Table A.

Table A- Oxford Sludge Tank Volumes

Tank Purpose	Number	Total Operational Volume* (m^3)	Construction
Primary Picket Fence Thickeners	2	800	Steel
Sludge Buffer Tank	1	170	Steel
Screened Sludge Holding Tank	1	600	Steel
Sludge Blending Tank	1	249	Steel
	1	214	n/a
Pre- THP Dewatering Feed Tank	1	36	Steel
THP Feed Silos	2	600	Steel
THP Process Units	6	132	Steel
THP Flash Tanks	2	60	Steel
Primary Digestion Tank 1 & 2	2	4730	Concrete
Primary Digestion Tank 3 & 4	2	3392	Steel
Digested Sludge Buffer Tank	1 part tank ** 1 whole tank	700 1830	Concrete
Digested Sludge Buffer Feed Tank	2	790	Concrete
Pre-Dewatering Feed Tank	1	65	Steel
Liquor Treatment Plant Balance Tank	1	810	Concrete
Liquor Treatment Plant (in two lanes)	1	2960	Concrete
Liquor Treatment Plant Decant Chamber	1	515	Concrete

* Operational Volume is the volume of sludge being stored above ground level

** To be taken out of service following containment solution construction

3.5 Containment Areas

The proposed option for Oxford involves 8 containment areas, refer to Section 4.1. The 8 containment areas identified in Figure 3-4 will inform the interpretation of the spill volumes in Section 3.6.

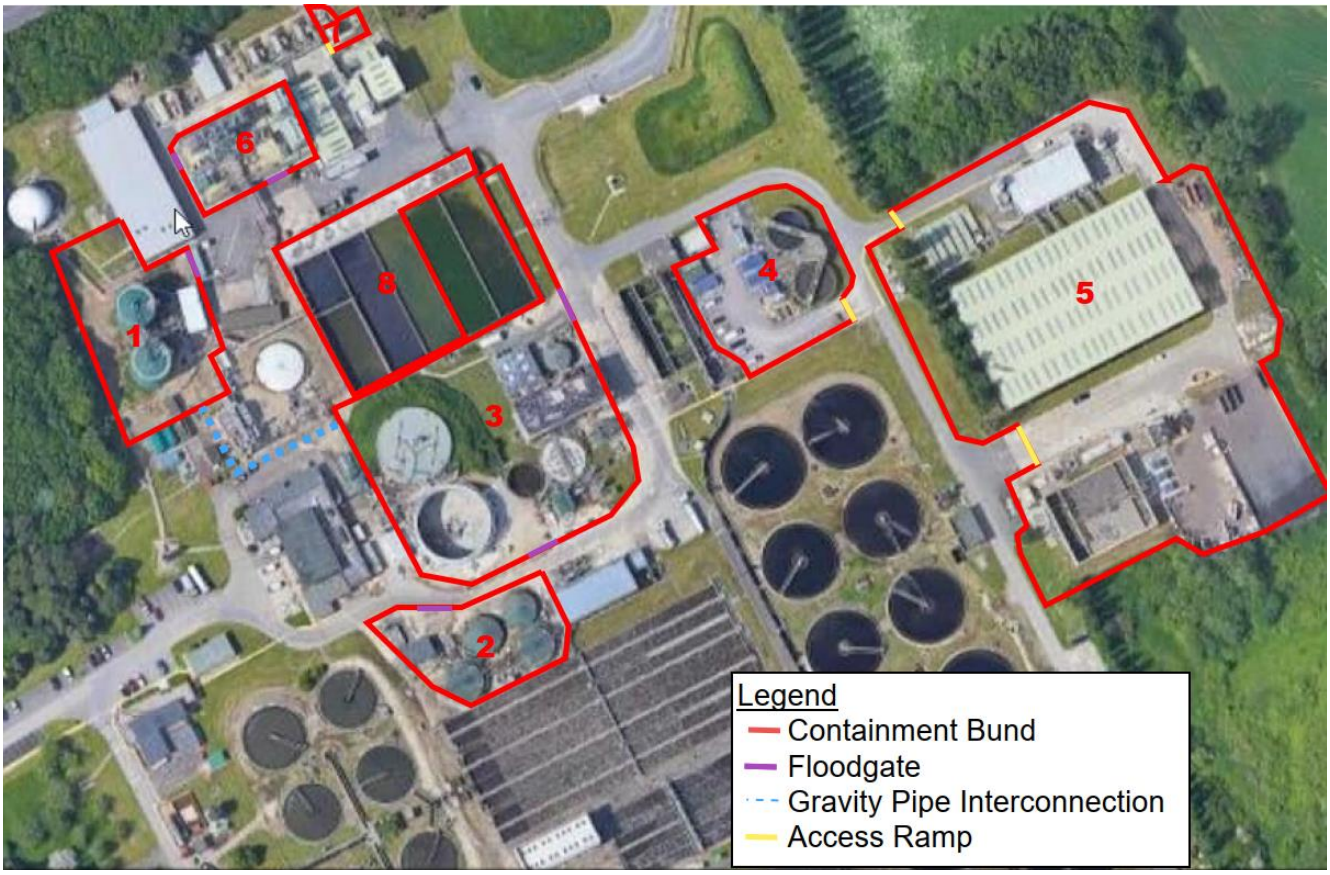


Figure 3-4 – Oxford Containment Areas

3.6 Total Spill Volumes

Each of the 8 containment areas are evaluated for the critical spill scenario individually, as shown in Table B. Area 1 and 3 have also been evaluated as interconnected for reasons explained in Section 4.2 The aggregate total critical spill volume for the Oxford site is 8722 m^3.

Table B – Critical Spill Volumes

Containment Area	25% Scenario (m^3)	110% Scenario (m^3)	Largest Tank + Rainfall Scenario (m^3)	Critical Spill Volume (m^3)
Area 2	316	440	501	501
Area 1 and 3 (Interconnected) ***Refer to Section 4.2.**	2146	2601	2945	2945
Area 4	173	380	487	487
Area 5	1088	1628	2448	2448
Area 6	183	330	374	374
Area 7	N/A	40	56	56
Area 8 ***Refer to Section 4.3.**	435	1912	1862	1912
Total Aggregate Critical Spill Volume				**8722m^3**

3.7 Constrained Spill Modelling

Modelling outputs for some of the containment areas were unable to be generated because the depths exceed the modelling software capability. Alternatively, manual calculations have been processed for each area and are summarised in Table C.

Table C - Constrained Area Manual Calculations

Containment Area	Top Water Level (mAOD)	Usable Containment Area (m^2)	Spill Containment Volume (m^3)
Area 2	63.86	740	501
Area 1 and 3	63.67	5770	2945
Area 4	62.73	1705	487
Area 5	63.37	10170	2448
Area 6	62.96	745	374
Area 7	62.55	264	56
Area 8	60.58	1821	1912

3.8 Site Topography

Figure 3-5 shows the site topography and significant buildings. Considering the topography of the sludge area, the high-resolution contouring revealed that the digesters are on higher ground relative to its surroundings, with the lowest ground residing in the north of the largest primary digesters, therefore the spilled sludge ultimately flow northeast to the nearby waterway if left uncontrolled.

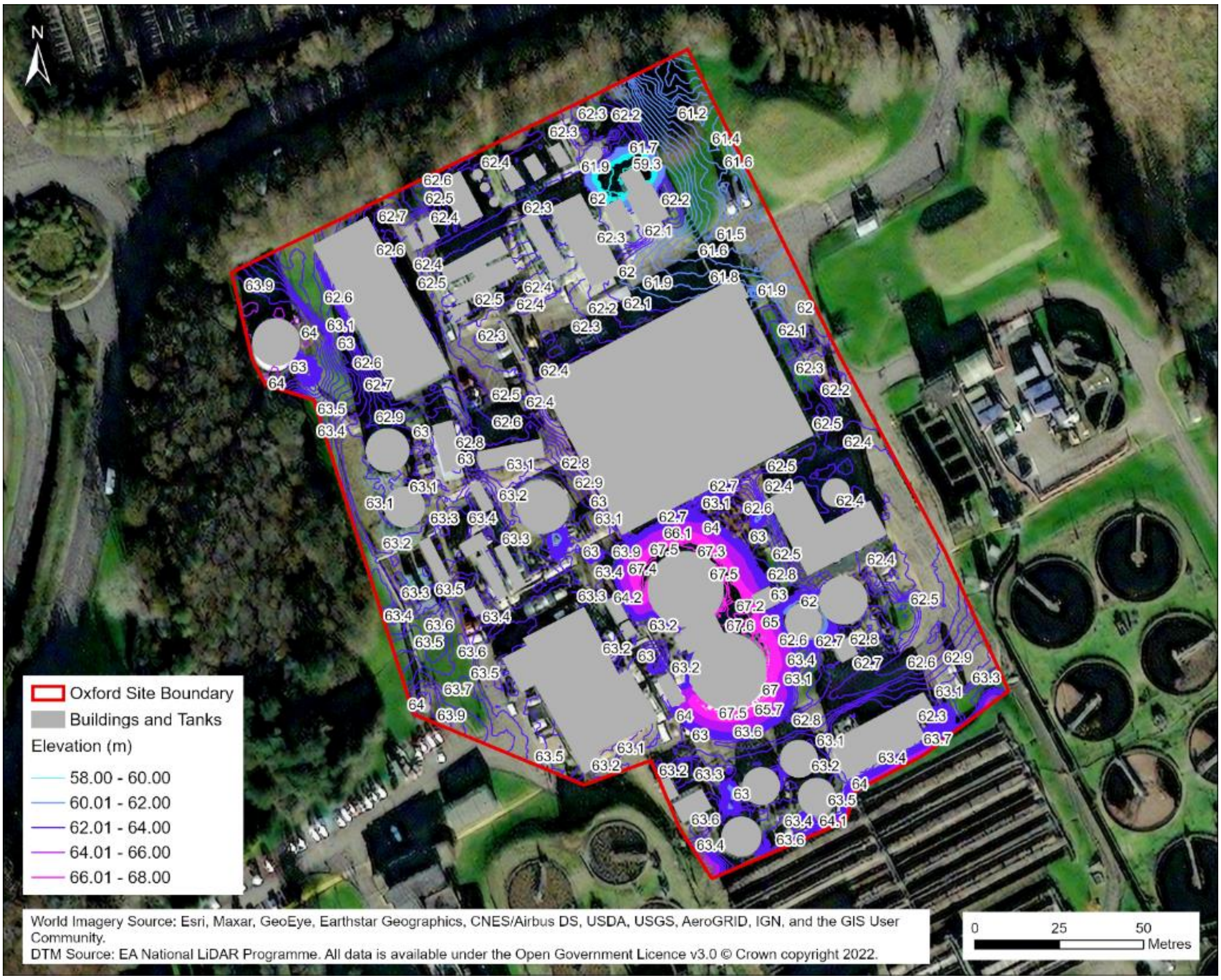


Figure 3-5 – Topography of the Oxford STW

3.9 Bund Wall Heights

The bund wall heights have been calculated and are shown in Table D.

Table D – Bund Wall Heights Summary

Containment Area	Top Water Level (mAOD)	Nominal top of impermeable slab level (mAOD)	Nominal top of Wall Level inc. freeboard (mAOD)	Nominal top of wall Height inc. freeboard (m)
Area 1 (Interconnected with 3)	63.67	63.15	63.92	0.77
Area 2	63.86	62.86	64.11	1.25
Area 3 (Interconnected with 1)	63.67	63.00	63.92	0.92
Area 4	62.73	62.44	62.98	0.54
Area 5	63.37	63.13	63.62	0.49
Area 6	62.96	62.21	63.21	1.00
Area 7	62.55	62.24	62.80	0.56
Area 8	60.58	59.60	62.1 (existing GL)	1.52

3.10 Operational Constraints

An aggregate total critical spill volume of 8722m^3 can be stored within the eight containment areas. A benefit of having the eight areas will mean that spills within one area are isolated and will not affect the wider sludge assets and have smaller clean-up footprints (except for spills within the interconnected Area 1 and 3). In addition, the main site access roads are not impacted by these close containment areas. Potential issues of working within these close containment areas have been mitigated by keeping the wall heights below the CIRIA guide maximum height of 1.5m.

The existing ground surfaces within each containment area will need to be replaced with impermeable surface e.g., concrete from which sludge can be cleared up easily. TW operation have stated that it would be difficult to clean up sludge from gravel areas as the gravel would also sucked up with the sludge.

Thames Water has indicated that the clean-up and return to operation is feasible in 3 to 4 days. Therefore, a three-day period following an incident has been allowed for in the design allowance for rainfall following the incident.

The sludge cake barn has been included in the proposed containment area due to lack of available space. Any spills onto the dried sludge cake would need to be passed through a centrifuge again to dry and re-thicken or sent back to the head of the works.

The proposed solution in Area 8 will reduce the volume of digested sludge buffer storage from 1.5 tanks to a single tank. This has been discussed with Thames Water Ops and agreed that this is viable as currently the half tank is normally used and the full tank is only used as an occasional overflow. It is thought that a single full tank will be sufficient.

3.11 Geotechnical and Environmental Constraints

Due to the close containment option proposed- there is minimal excavation required and geotechnical properties are unlikely to have a critical impact on this project. In addition, very little vegetation removal (if any beyond grassed surfaces) is required as part of this solution. With careful planning of the footings on the western section of Area 1 and the northern section of Area 7, impacts to the nearby woods should be avoided.

3.12 Other Constraints

Due to the brownfield nature and lack of open space of the Oxford treatment site, several major service relocations will be required in order to install the proposed bund arrangements, notably:

- Above ground pipework in Areas 1 and 3 will need to be temporarily relocated during construction and then realigned around/over the bund wall once constructed.

3.13 Design allowance for rainfall

The containment volume, when not dictated by the 110% or 25% containment rules includes an extra allowance for rainfall that may accumulate within the contained area before and after an incident has been made. The CIRIA guidance recommends that the containment volume should include an allowance for the total rainfall accumulated in response to a 1 in 10-year return period events for the 24 hours preceding an incident and for an eight-day period following an incident or other time period as dictated by site specific assessment. Thames Water has indicated that the clean-up and return to operation is feasible in 3 to 4 days. Therefore, a three-day period following an incident has been allowed for in the design allowance for rainfall following the incident. The arising average rainfall depths for a 1 in 10-year storm over the event period for Oxford is 72mm. It should be noted that the rainfall depths for Oxford have been estimated using the depth-duration-frequency rainfall model contained on the *Flood Estimation Handbook (FEH),* which provides location specific rainfall totals for given durations and return periods.

4. Secondary Containment

The constituent parts of secondary containment are:

- The contained area itself.
- The transfer system.
- Isolation of the drainage from both the contained area and from the transfer system.

For Oxford, where possible, existing features of the site (e.g., suitable structures and impermeable surfaces) are used as much as possible to provide the secondary containment to reduce cost. The options considered, modifications and their functionality are listed below:

- Re-use of existing tanks, where possible to provide containment storage.
- Bund/walls to contain liquid. The heights of bund/walls given in Section 3.9 incorporate a 250mm freeboard consideration for potential surge (to reflect the planned use of concrete walls with a recurved profile to return flow back on itself) in accordance with CIRIA.
- Floodgates to isolate the close certain containment areas while still providing operational access when necessary.
- Interconnection between containment areas 1 & 3 to minimise bund height, refer to Section 4.2.

4.1 Containment Option 1 – Eight Close Containment Area

One option was developed for containment on the Oxford site after input and agreement with Thames Water Operations representatives in a meeting on the August 4th, 2022 with three additional areas (Areas 6, 7 and 8) added subsequently.

The proposed option for Oxford involves 8 containment areas, 7 bunded containment areas and 1existing tank modified to provide containment, see Figure 4-1.

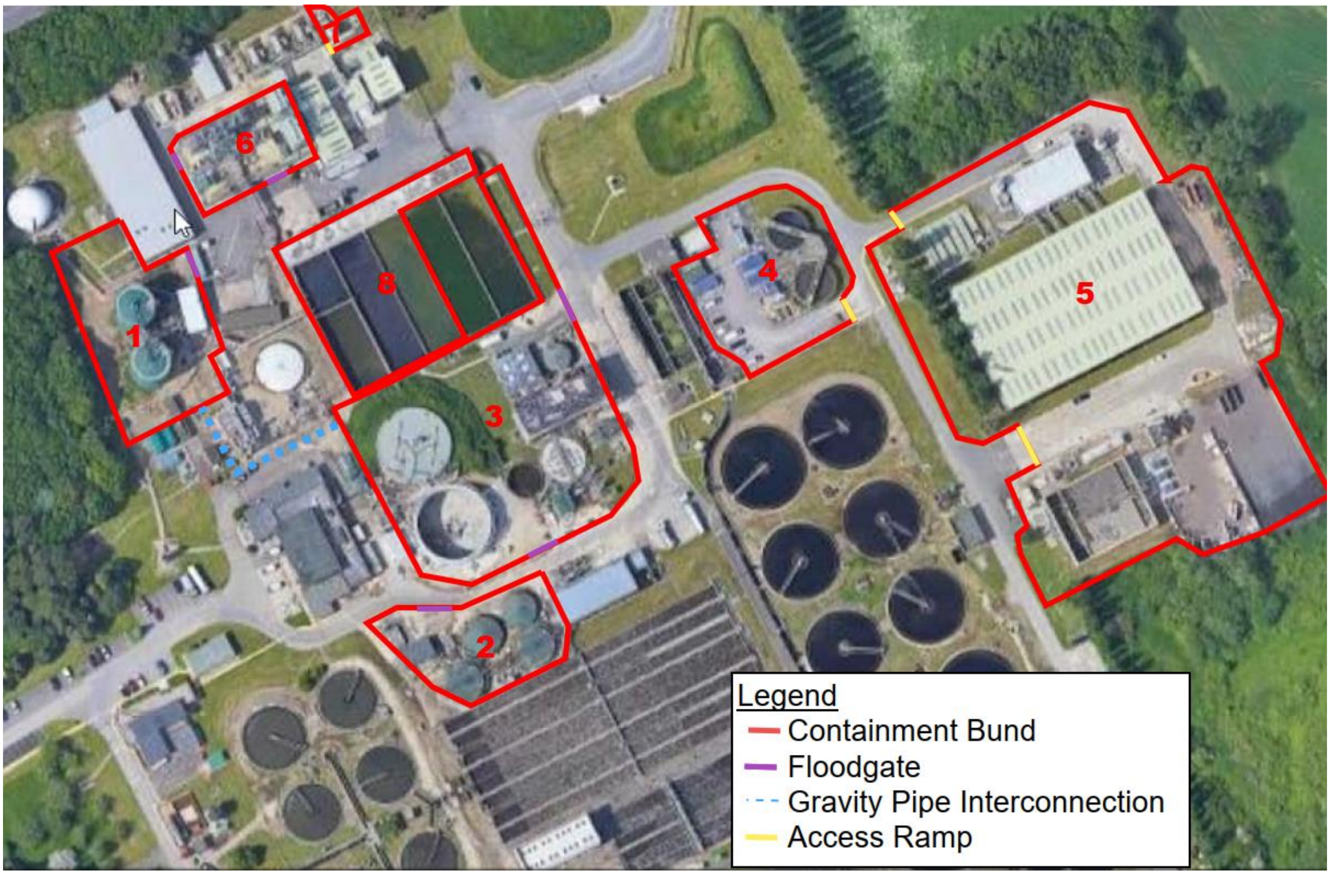


Figure 4-1 – Option 1 Eight Close Containment Areas

4.2 Interconnection of Area 1 and 3

A bi-directional gravity pipe connection between area 1 and 3 will enable the reduction of the bund wall height in both areas. A connection between the two areas provides increased the storage capacity without increasing the critical spill volume, thereby reducing the required maximum wall height to 0.80 m (inc. freeboard). This represents a significant cost saving in terms or bund construction costs as well as favourable operational conditions with a lower height bund wall (increasing visibility, light dispersion and airflow).

An isolation valve is recommended to be installed on this gravity line for operational flexibility, but the valve must be left normally open to provide the required capacity in the event of a sludge spill.

4.3 Area 8 Existing Tank Modifications

Containment Area 8 forms the containment for the Digested Sludge Buffer Tank. In order to provide the required containment, some modifications to the existing structure are required. The following modifications are proposed to the Digested Sludge Buffer Tank to form the Area 8 containment and shown on Figure 4-2 below.

- Pipework from primary digesters to be modified to feed to Tank 2 of the existing structure.

- Tanks 1 and 3 to remain empty with a sump pump provided to remove rainwater allowing the containment volume to be provided to the eastern and western sides of the Tank 2.

- A new wall is required at the southern end of Tank 2 to provide the containment at this end of the structure.

- The existing pipe gallery at the northern end of the structure will provide the containment to the northern end of the structure. The pipe gallery sits approximately 2.5m below ground level and would be able to provide approximately 590m³ of containment volume if fully utilised.

- In order to ensure the full containment volume is provided wherever in Tank 2 the spill occurs small diameter cores are to be provided, to ensure hydraulic connectivity.

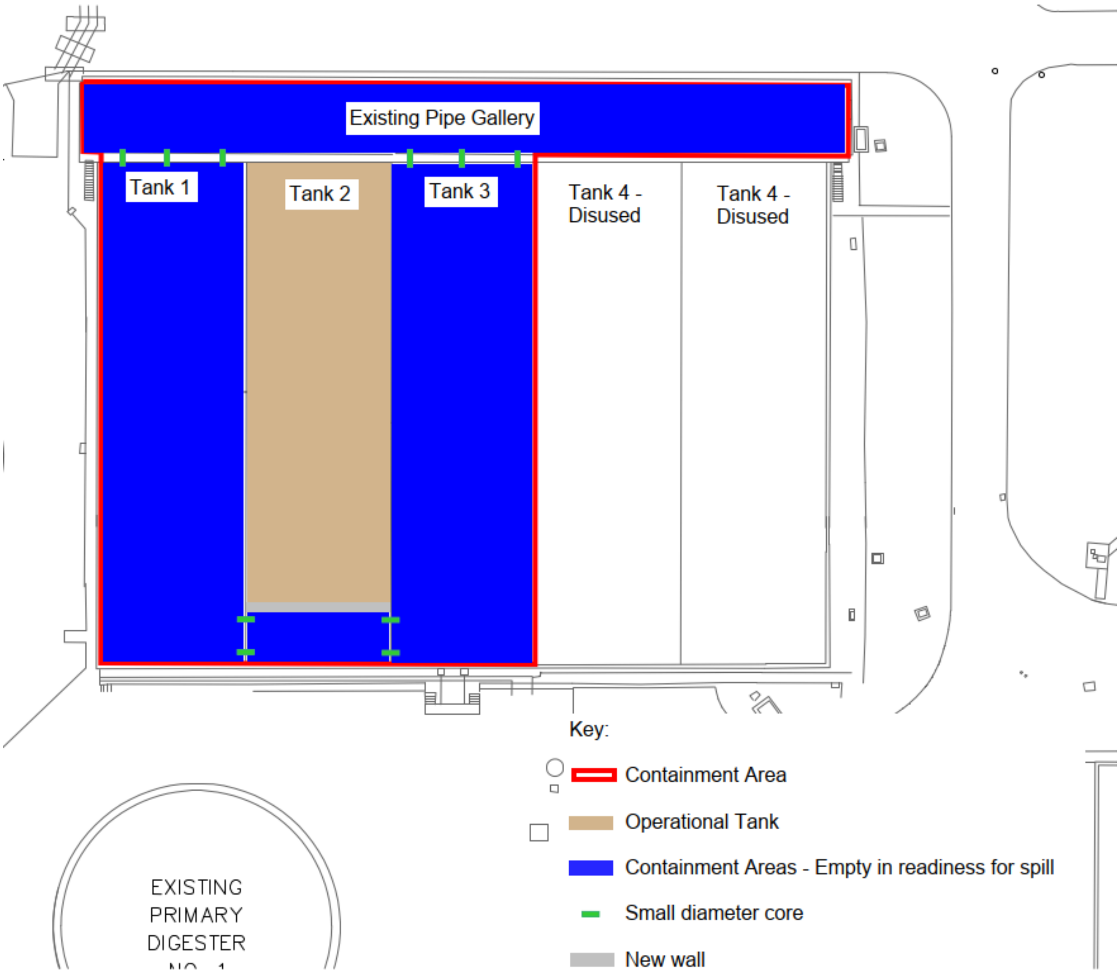


Figure 4-2 - Proposed Containment Area 8 arrangement

4.4 Impervious Areas

All grass and gravel areas will be excavated and resurfaced with concrete to mitigate seepage into the local ground and soil. This also aids cleaning procedures following a spill.

4.5 Jetting and Surge Flows

There is a risk of jetting occurring onsite as is often the case with close containment areas. It is infeasible for the eight containment areas to provide enough distance from the tank to prevent jetting from all angles due to space constraints.

Surge effects have been partially mitigated by the bund profile (recurved to return flows back on itself). Any flows escaping the bund flow will be captured by the operation of the site's road drainage providing a conveyance pathway to the head of the works.

The likelihood of jetting occurring however is deemed low as failure is more likely to begin with major seeping from the tanks which would be spotted during routine site walkabout tours each day.

4.6 Flooding

According to the UK Government's Flood Map for Planning, the sludge area is completely in Flood Zone 1, as shown in Figure 4-3. Areas located in Flood Zone 1 have less than a 1 in 1000 probability of river flooding. Flood mitigation methods are unlikely to be required in this region. The north-eastern tip of the STW is close to an unnamed stream that joins Littlemore Brook which is susceptible to flooding.

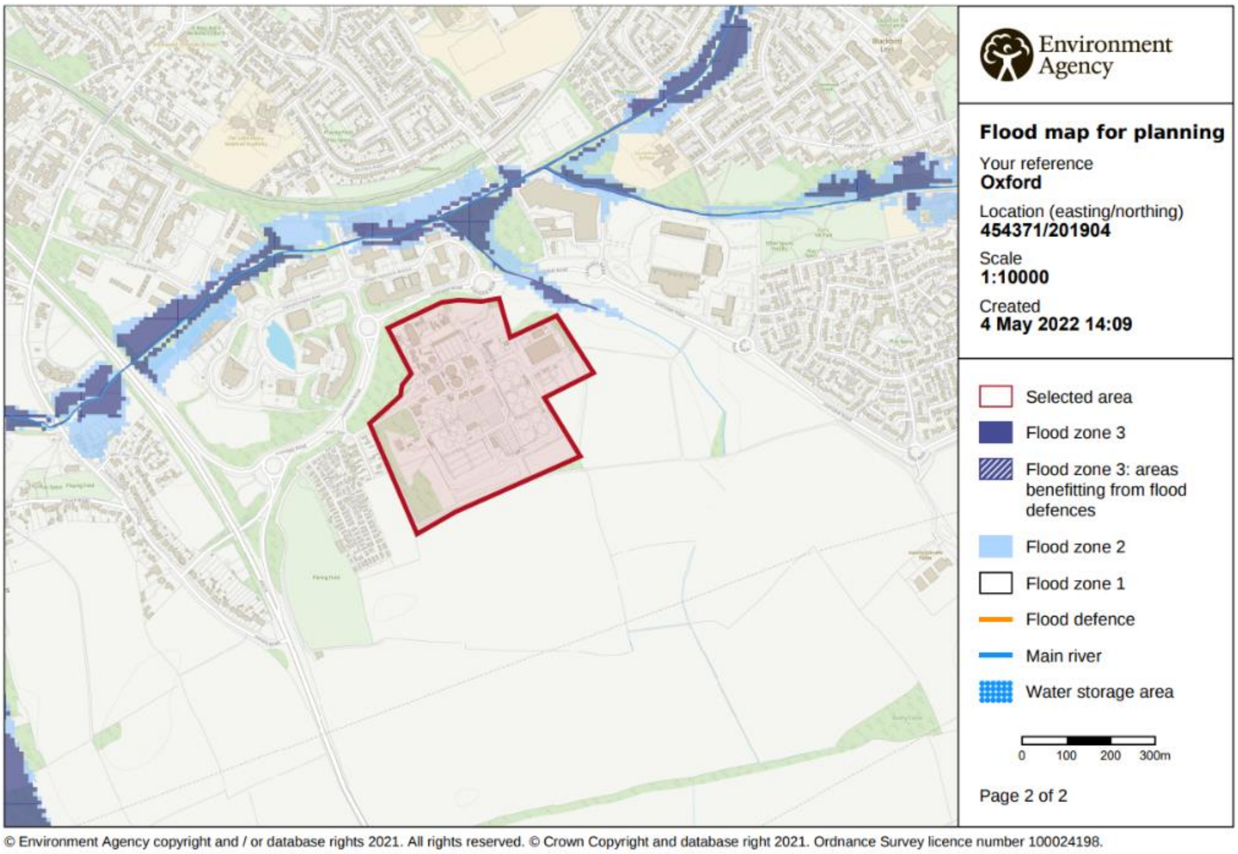


Figure 4-3 - Extent of Fluvial flooding in Oxford due to extreme weather events

4.7 Identification of Preferred Option

The preferred containment option is Option 1 the eight containment areas within interconnecting Area 1 and 3 and modification to an existing tank to provide the containment in Area 8. Option 1 has been selected based on low cost, high operational flexibility and minimal impacts to site access routes.

Other bund wall alignments were initially discussed with Thames Water but were ruled out because the site is vast and the sludge assets are disparately located. Additionally, it is not favourable to consider wide containment in an area this large because the subsequent rainfall capture would increase the critical spill volume.

4.8 Potential issues for solution detail (Inc H&S)

- Flood gates identified for areas where frequent vehicle access is not anticipated. Pedestrian steps to be provided to reduce frequency of operation if needed.
- Review and update (if required) the safe systems of work for working within the pipe gallery area.
- Confirm that the bunding does not impact the DSEAR rating of existing plant
- Detailing and final positioning of the bund walls must consider ongoing maintenance access.
- Potential service clashes along the proposed gravity pipe connection route are currently unknown and requires further investigation as part of fixing the final alignment.
- Jetting escape is a risk for this site due to space constraints and the site drainage system acts as the tertiary conveyance.

5. Site Drainage and Liquor Returns

5.1 Process flow diagrams

Refer to Figure 5-1 for the Process flow diagram with the current tank configuration.

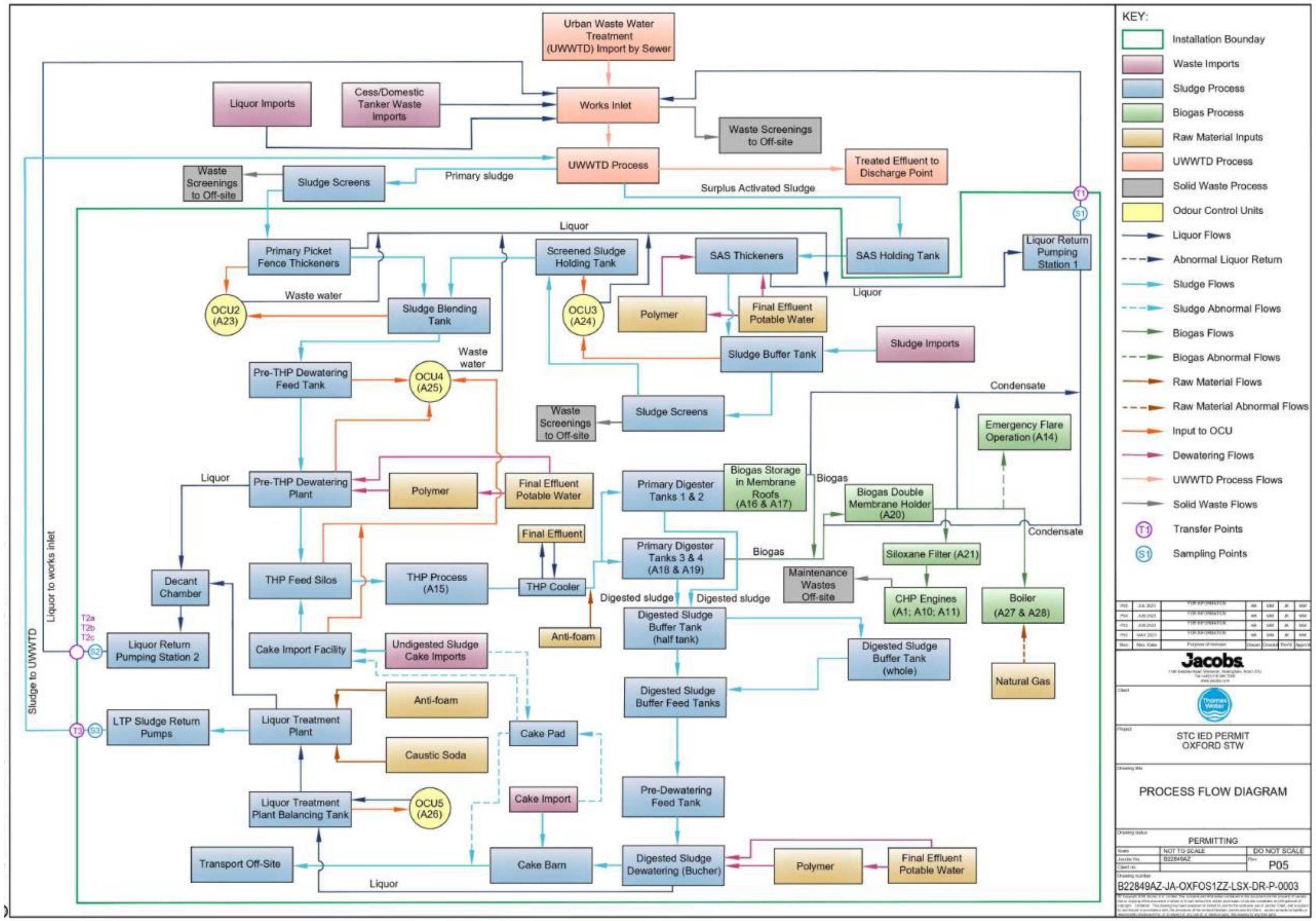


Figure 5-1 - Process Flow Diagram including returns/ liquor transfer

5.2 Foul, Process and Effluent Drainage

Figure 5-2 (excerpt from TW Drawing OXFOS1ZZ-DPL-001) shows the existing drainage lines within the sludge asset area. There is missing drainage information around these sludge tanks, hence a survey has been requested.

Refer to one callout area, Figure 5-3, around the SAS Belt Area and to the Northeast corner where all road gullies and combined sewer lines meet. These are stated to discharge to a watercourse or to Minchery Farm SPS. This area is critical, and the discharge points need to be confirmed for suitable sludge containment options. These lines may require automatic isolation or diversion to ensure any spill flows return to the head of the works. Drainage lines that currently discharge to waterways will need to be isolated in normal operation in order to satisfy CIRIA containment guidelines or alternatively new drainage routes could be installed to pump this back to the head of the works.

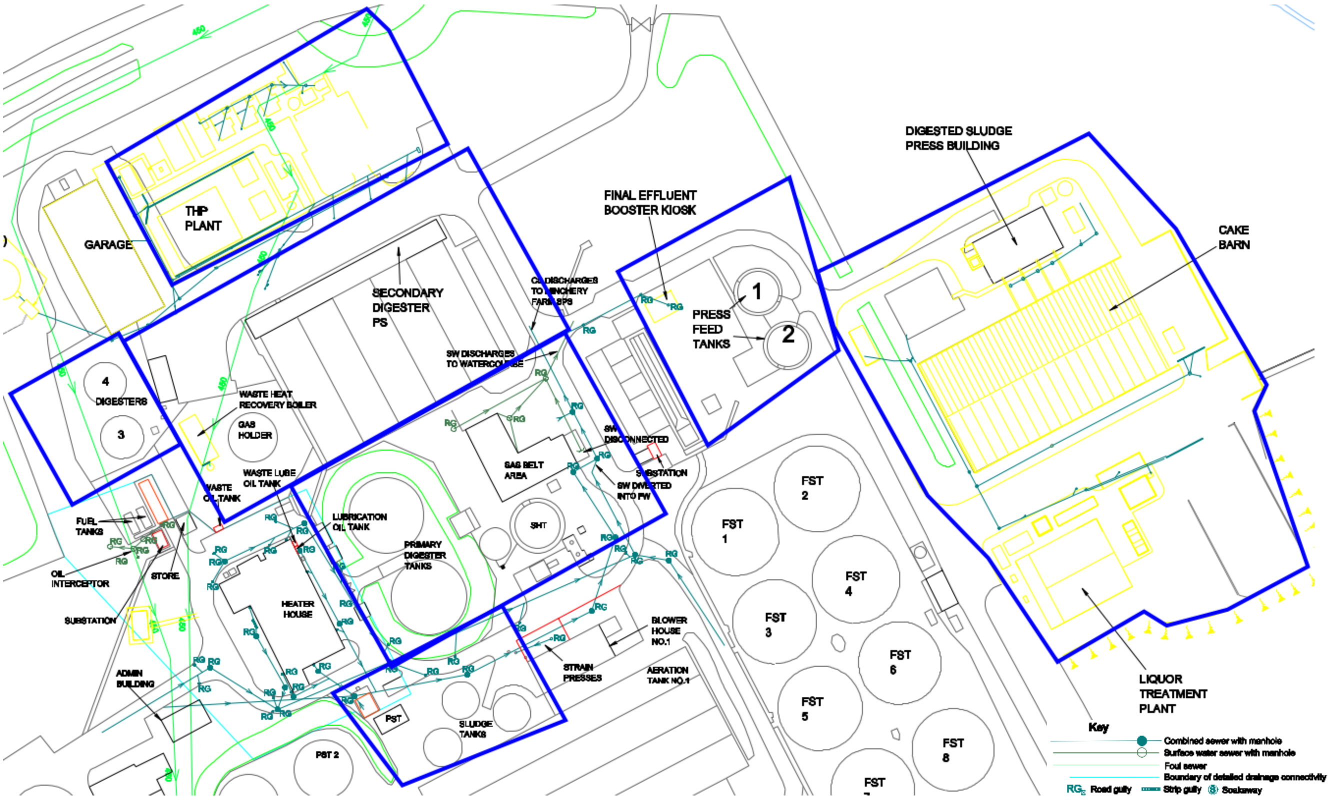


Figure 5-2 – Oxford Drainage Drawing

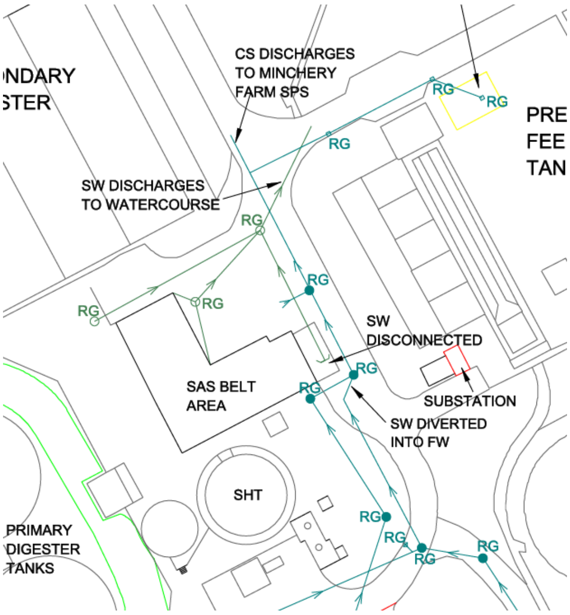


Figure 5-3 – Waterway Connection Highlight

5.3 Automatic Isolation Valves – Site Drainage and Tanks

For the catastrophic loss of containment scenarios for the areas discussed, such a loss could be automatically detected by the level sensors in the tanks. A catastrophic failure would be identified by the rate of change in tank level being larger than expected at normal operation. The signal from the sensors would be used to generate an alarm.

In the event of a catastrophic sludge spill, flows entering the head of the works via the drainage pipes could adversely impact the sewage works treatment process. Therefore, in the event of a catastrophic loss of containment, this line should be isolated.

It is recommended that float operated isolation valves are installed on all outgoing drainage lines from the containment area. These valves will remain normally open but will close when high levels in the existing drainage system are encountered. This drainage configuration will have the following impacts:

- In heavy or intense rain events these drainage isolation valves may be triggered, and operators onsite will need to manual operate these valves to release flows into the existing drainage network.
- In minor or slow flow tank spill events, the sludge spill will flow into the exiting drainage network (and into the head of the works) unless operators intervene to isolate the drainage networks. Due to the flow to full treatment at Oxford being large, minor spill flows will not adversely impact the process.
- In most locations, to accommodate the new isolation valves, new manholes need to be constructed over the existing drainage lines.

6. Conclusions

This section summarises the findings of the containment assessment options report for Oxford STW.

The overall site risk rating has been identified as medium which means that class 2 secondary containment is required.

This assessment focuses on the provision of the secondary containment and outlines the options. The nature of the site allows the tank groups to be addressed separately (provided the gravity line is manually isolated between the interconnected areas 1 & 3). The aggregate total critical spill volume for the Oxford site is 8722m^3.

One option was developed in detail for sludge containment at Oxford STW – eight close individual containment areas, with an interconnection between Area 1 and 3 and modification to the existing tank in Area 8. This option will include 7 bunded containment areas with the bund wall maximum height being 1.25m (inc. freeboard) in Area 2, the walls to other areas are less than 1m. Areas 1 & 3, 2 and 6 will require floodgates for entry. The floodgates will be normally-closed and alarmed via SCADA to indicate when they are not-closed. Entry in Area 4, 5 and 7 will be via access ramps because the containment depth is less than 0.3m. In addition to the containment elements, the ability to isolate site drainage connection system will be required to mitigate the risk of unmanaged flows impacting the sewage treatment works and prevent spills entering the waterway. Replacement of permeable surfaces will minimise clean-up time and effort.

Freeboard allowances and the profile of the containment bund wall partially provides mitigation against surge effects. Jetting escape is a risk for this site due to space constraints.

Appendix 1 - ADBA Site Hazard Risk Assessment Summary for Oxford STW

The ADBA Industry Guidance and CIRIA C736 state how the site hazard rating of the site risk and classification are to be calculated. A summary of the hazard risks for Oxford STW are as follows:

Source – There are two sources that have been identified:

1. Domestic and trade effluent Wastewater sludges, both in a raw, semi treated and treated state.
2. Polyelectrolyte chemicals (ferric sulphate) for sludge thickening.

The Source Hazard rating was determined as **High.**

Pathway – These are the key elements that have been identified:

1. The incorporation of containment and management of the interface with the site drainage system results in a low determination over riding other pathway elements, however
2. The medium determination is driven by the sludge treatment centre being connected to the sewage treatment works (noted that this item makes no differentiation of the size of the sewage treatment works)

Consequently, the Pathway Hazard rating was determined as **Medium.**

Receptor – The Residential area west of the STW (Park home estate nom 200m from the STC) triggers a medium hazard. Oxford Science Park is closer but triggers a lower rating.

No other receptors were triggered.

The Receptor Hazard rating was determined as **Medium.**

Likelihood – The mitigated likelihood is **low**, which reflects the use of materials, the tank systems do not have a history of failure, the tanks are designed to British Standards and installed by competent contractors and Thames Water undertake regular site tours giving the opportunity to identify early indications of potential issues.

Based on the information above the overall site risk rating was calculated to be **Medium** which means that **Class 2 secondary containment** is required.

Source Risk	Pathway Risk	Receptor Risk	Site Hazard Rating	Likelihood	Overall Site Risk Rating
High	**Medium**	**Medium**	**High**	**Low**	**Medium (Class 2)**

Appendix 2 - Tank Covering High Level Commitment

Thames Water commits to covering permitted open top tanks at the facility in accordance with the IED and BAT 14. Thames Water will take a risk-based approach, including use of PAS110, to determine our approach to abatement if required for individual tanks at Oxford. Thames Water confirm that our approach to abatement includes use of a biogas system if required. Engineering design assessment may result in replacement of tanks or reduction in number of applicable tanks. Our programme of delivery will need to be phased so that for each location a minimum number of existing AD tanks are always in continued operation to ensure process requirements are met. Thames Water will use PAS110 to determine whether individual tanks are biologically active. Non-biologically active tanks will be considered in accordance with the guidance Covering Slurry Lagoons (publishing.service.gov.uk).