J840 – STC IED Containment

Deephams STW – Containment Options Report

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Thames Water

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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 proposal for Deephams.

Deephams STW is bordered by Meridian Way to the west, and the Lee Valley Canal/William Girling Reservoir to the east. The site serves to treat the sewage for a population equivalent of 989,000. The catchment area (154 square miles) covers several north London Boroughs and part of Hertfordshire. The sludge treatment centre shares the same site as the sewage treatment works. There are 16 sludge tanks as part of the permit area with the total operational sludge volume is 40,954 m^3.

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.

The critical spill volume for this site has been identified as 10,297 m^3 which is the volume associated with 25% of all sludge assets on site. This value is significantly larger than the other two CIRIA scenarios including spilled tank plus rainfall and 110% of largest sludge tank at Deephams STW. (10,297 vs 6,270 and 4,231m^3 respectively).

Most of the tanks are steel, the site manned and subject to regular tours by operations staff. The site generally grades to the southwest.

One option was developed in detail for the sludge containment at Deephams STW – wide area containment with lagoon storage. This option constitutes of a bund wall with a maximum height of 1.09m on the southwestern section of the containment area. In addition, excavating and refurbishing the existing unused lagoon area (to 6,014 m^3 capacity) will provide the initial storage area for sludge spills. The volume of the lagoon is greater than the largest individual tank volume of 3,846m^3. Containment ramps will be constructed across the road crossings to the east of the area, whereas flood gates are required to be installed on the western walls due to the natural topography. In addition to the containment elements, the ability to isolate the drainage connection system for the containment area will be required to mitigate the risk of unmanaged flows impacting the sewage treatment works.

The results of the constrained spill mapping show that a catastrophic spill will be contained with the proposed bund alignment and lagoon area. Spills of less than 50% of the critical volume can be entirely contained within the lagoon which provides operational flexibility and clear site access. The contained spill modelling shows that the depth within the containment bund of a spill would have a maximum TWL of 12.09m.

Bund heights are being set to provide freeboard considering both static conditions when the containment has been filled and during the transient condition at initial failure. The bunds have been identified to be concrete due to space constraints. The bund profile will facilitate turning the flow back on itself to mitigate the risk of overtopping during the initial failure.

In addition to the creation of bunds, existing grass or gravelled areas will be replaced with a bound impermeable material (high cement replacement concrete) to provide a surface that can be cleared of sludge to meet an eight-day recovery period. These new concrete areas with the existing concrete roads and slabs to provide the impermeable base to the containment area as a whole. Containment ramps will be constructed across the road crossings to the east of the area, whereas flood gates are required to be installed on the western walls due to the natural topography Containment ramps will be constructed across the road crossings to the east of the area, whereas flood gates are required to be installed on the western walls due to the natural topography There is the potential for some flow to overtop the access ramps during an initial burst on the eastern section of the site which is addressed by tertiary containment and conveyance to the site drainage system which discharges to the inlet works. Whilst the site is identified as requiring Class 2 containment (impermeable soil with a liner), the proposed solution is intending to adopt concrete (with no liner) based on the permeability of the concrete, inherent strength and long-term mechanical resistance to cope with potential cleaning activity. Remedial works to existing concrete slabs/roads will be undertaken to ensure that they provide a competent surface, for example resealing of joints.

General layout of the proposed solution:

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.

Deephams STW (Figure 2-1 - Satellite view of Deephams Sewage Treatment Works) is in Edmonton, London. The site is bordered by Meridian Way (A1055) to the west, and the Lee Valley Canal/William Girling Reservoir to the east. The site serves to treat the sewage for a population equivalent of 989,000. The catchment area (154 square miles) covers several north London Boroughs and part of Hertfordshire.

The current assessment identified gaps between the existing conditions of the sludge assets, refer to Figure 2-2, in Deephams STW and the requirements to meet the industrial standard (i.e., CIRIA C736 and The Anaerobic Digestion and Bioresources Association Limited (ADBA)). Site-specific risks, credible failure scenario and design containment volume for the Deephams STW were identified through a desktop study, Light Detection and Ranging Analysis (LiDAR) analysis and a site visit.

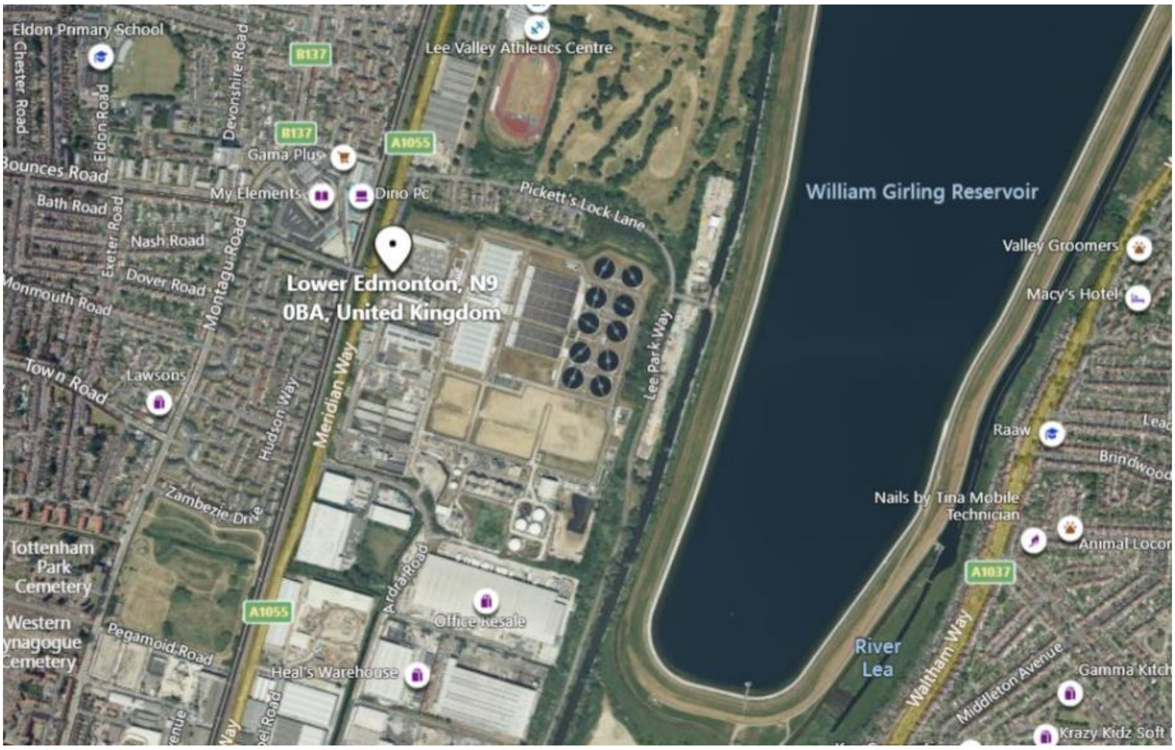

Figure 2-1 - Satellite view of Deephams Sewage Treatment Works

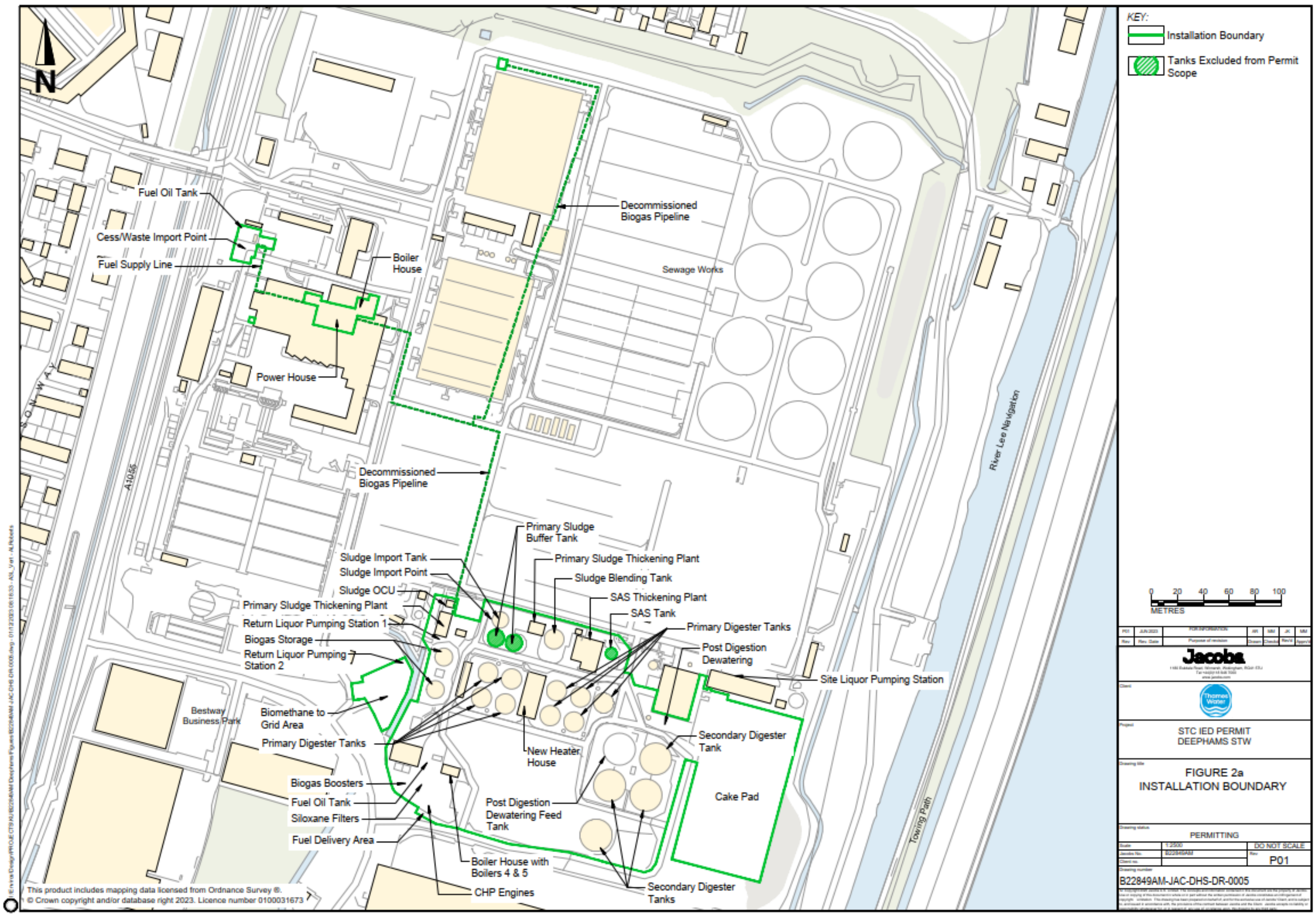

Figure 2-2 - Boundary of the permitted IED area and the assets contained within Deephams STW

3. Proposed Containment at Deephams 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 below;

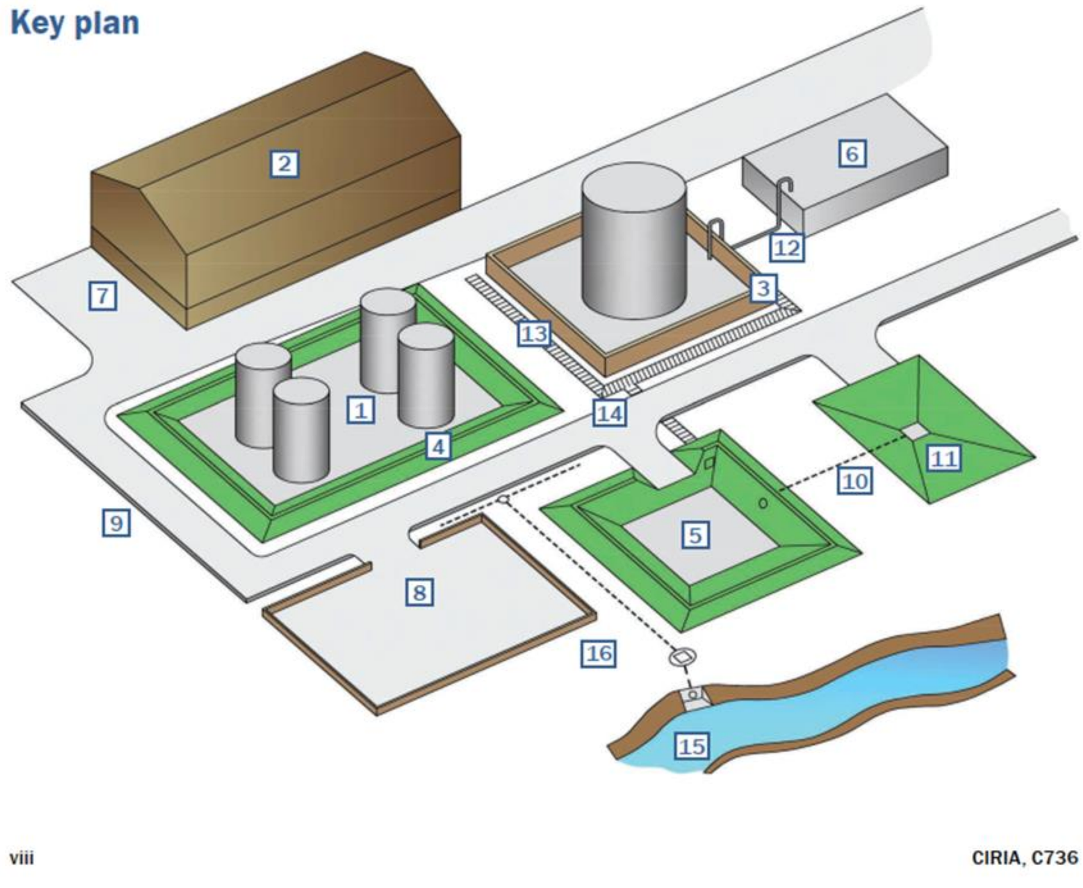

Figure 3.3 - Diagram of primary, secondary and tertiary containment examples

-**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 can provide 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

Hydraulic modelling has been applied to assess the uncontained spill event following a catastrophic failure of the largest secondary digester tank within the site only (3,846 m^3), without any contribution from rainfall. The 2D model generated uses the TUFLOW software package (Version 2020-10-AC), which can be used for simulating depth-averaged, one and two-dimensional free-surface flows exhibited with floods and tides. TUFLOW's implicit 2D solver, solves the full two-dimensional, depth averaged, momentum and continuity equations for free-surface flow using a 2nd order semi-implicit matrix over a regular grid of square elements. Furthermore, it includes the viscosity or sub-grid scale turbulence term that other mainstream software omit.

The Digital Terrain Model (DTM) used in the model was of 1m resolution and the footprints of buildings and tanks were omitted from the model. The dimensions of the tank were used to calculate a constant flow of liquid in all directions from the circumference until it was emptied. Areas with different roughness coefficients were delineated using aerial imagery e.g., liquid would flow more easily over roads and paths as opposed to vegetated ground. The model outputs are 2m resolution with a timestep of one second. The model was run until the liquid front was no longer moving. Default parameters were used in the simulation and the model was stable with a mass balance error below the acceptable 1%.

As seen from Figure 3-1 the sludge spill mapping of an uncontained event in Deephams STW shows that a potential sludge spill from one of the Secondary Digesters will not be self-contained within the site and therefore passive containment needs to be implemented to safeguard the nearby receptors. According to the model, the spill will leave the site boundary in approximately 5 minutes after failure of one of the digesters.

According to the modelling output, the bulk of the sludge will travel westward and southward, leaving the site boundary. The spilled sludge will then flow westward past the Primary Digesters and Gas Holders, to reach the west side of the Pymmes Brook and downstream under the Ardra Road and will continue into the empty grass field (Pines Green) behind Crown Workspace warehouse building.

A large volume of sludge will further flow past the southern boundary into Lidl Warehouse's truck loading bay, where it will travel west and eastward, covering most of the space. Sludge will spread to the east into Pymmes Brook, a minor tributary to River Lea, that runs on the border of the east boundary of the STW, where some travels upstream but mostly downstream, past the Biffa Edmonton Material Recycling Facility.

The rest of the release will remain within the site boundaries and flow eastward into the cake storage ground while most of the spill will spread north of the Primary and Secondary Digesters covering the empty grounds.

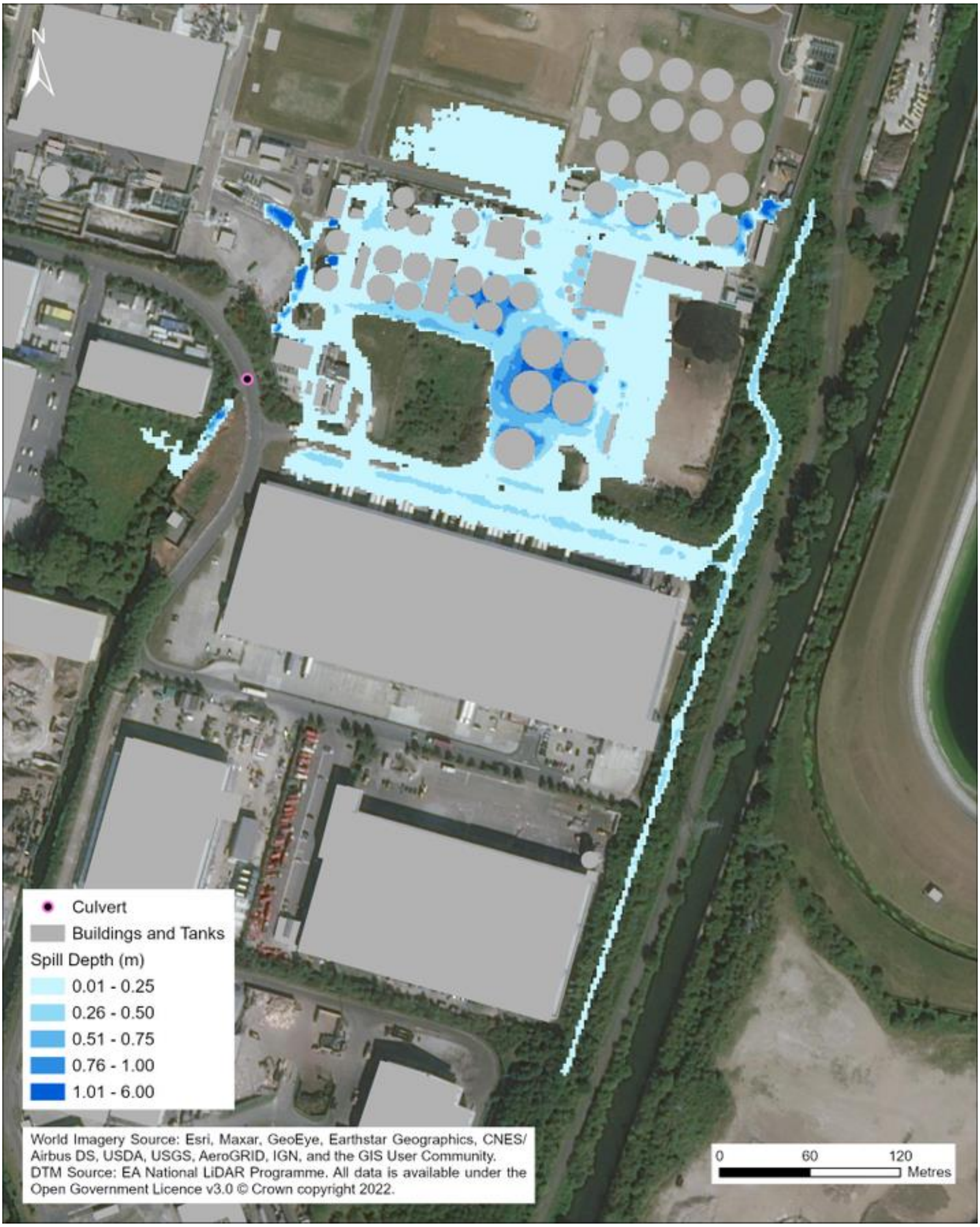

Figure 3-1 - Uncontained Spill Model Results

3.3 Site Classification

Based on the use of the ADBA risk assessment, considering the source, pathway and receptor risk Deephams site hazard rating is deemed to be High. 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**	**High**	**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 16 tanks in total containing sludge, most of steel construction, with a total operational sludge volume of 40,954 m^3 can be seen in Figure 2-2.

The principal sludge holding and digestion tanks at Deephams contained within the IED permitted area are detailed in Table 1.

Table 1 – Sludge Tanks and Volumes

Tank Purpose	Number	Operational Volume (m^3)	Total Operational Volume (m^3)	Construction
Sludge Import Tank	1	283	283	Steel
Sludge Blending Tank	1	804	804	Steel
Primary Digester Tanks	8	2,253	18024	Concrete
	1	2,253	2253	Steel
Secondary Digester Tanks	4	3,846	15,384	Steel
Post Digestion Dewatering Feed Tank	1	3,846	3846	Steel
		Overall Total	**40,954**	

3.5 Total Spill Volumes

The critical spill volume for this site has been identified as 10,297 m^3 which is the volume associated with 25% of all sludge assets on site. This value is significantly larger than the other two CIRIA scenarios including spilled tank plus rainfall and 110% of largest tank within Deephams.

3.6 Constrained Spill Modelling

For the wide area containment at Deephams, the modelling showed that 10,297 m^3 can be stored within the bunded area shown by the red boundary in Figure 3-2. In the critical spill scenario, the highest water levels will be towards the southwest of the site, while the southeast of the site will only experience localised pooling. This would only occur on the rare and unlikely occasion of multiple catastrophic tank failures.

The constrained modelling outputs for the reduced spill scenarios are shown collectively in Figure 3-3. This shows that for the 20% and 50% (of the critical spill volume) scenarios, spills can be contained in localised spill areas and within the lagoon which will minimise site operational disturbance.

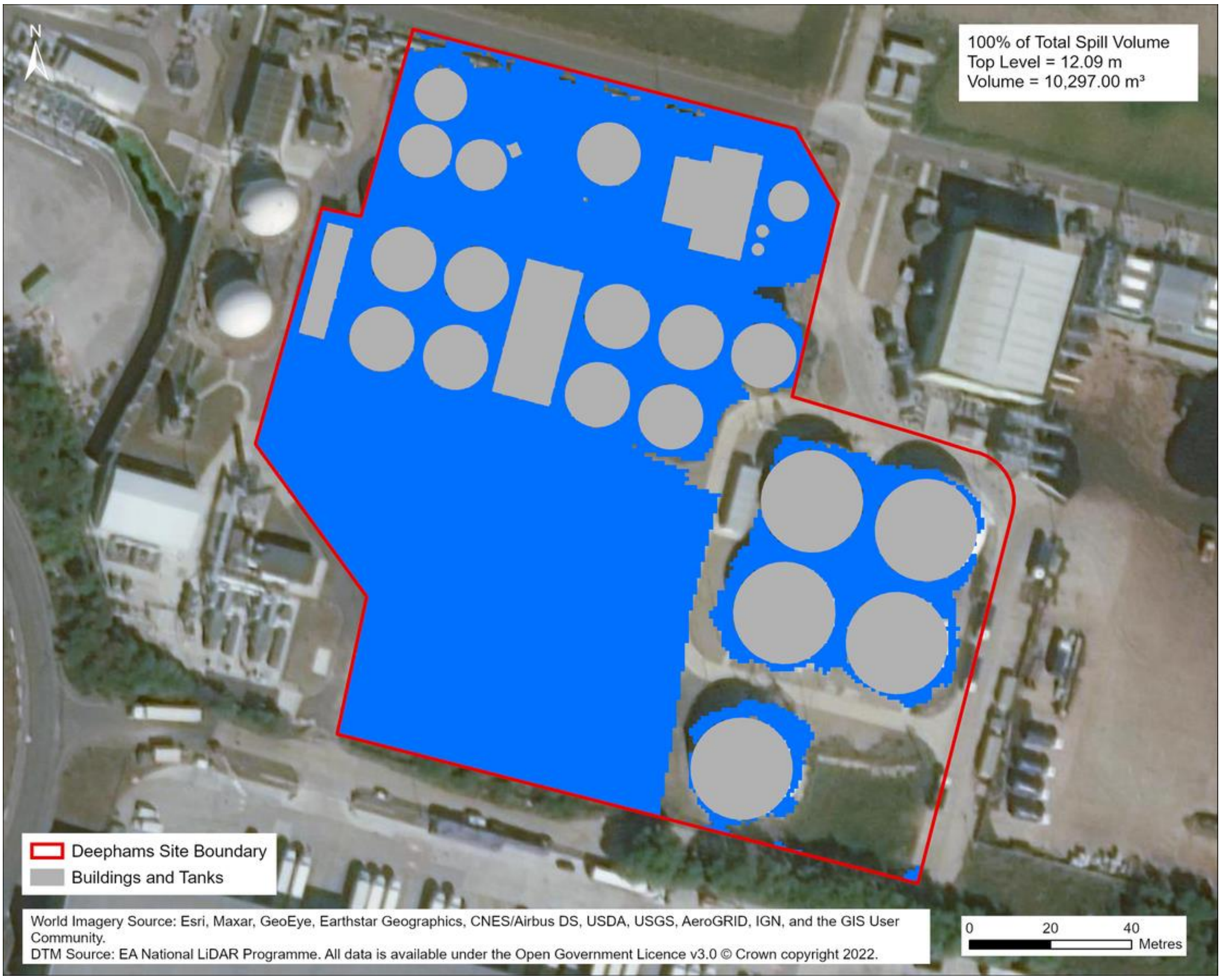

Figure 3-2 – Deephams 100% Contained Model

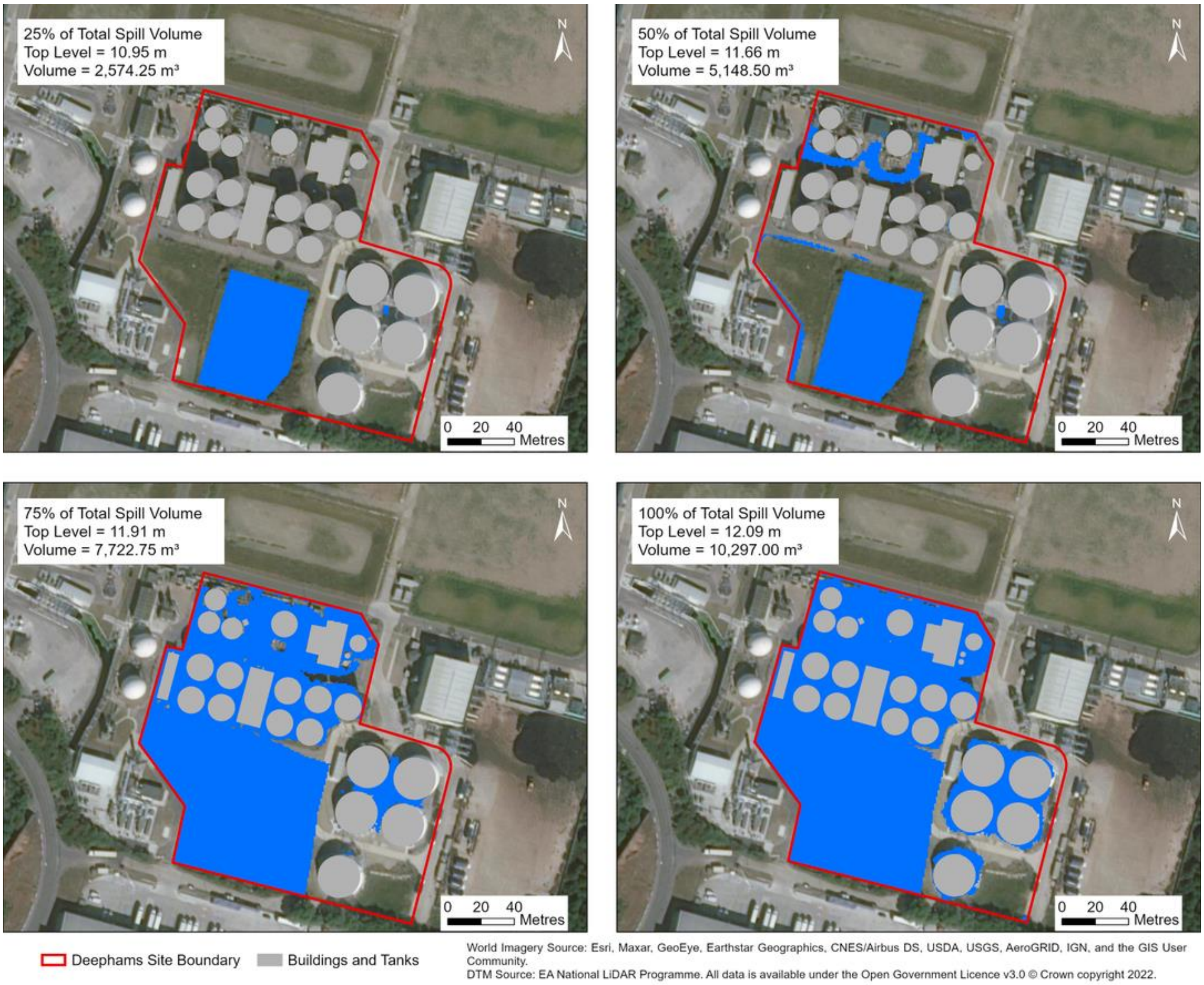

Figure 3-3 – Deephams All Spill Scenarios Contained Model

3.7 Site Topography

As can be interpreted from the site's topography shown in Figure 3-4 and Figure 3-5 there is a risk of spilled sludge flowing to the north and south west of the site and making its way into nearby waterway tributaries. This site has a high point to the southeast around the large secondary digesters. Other high points include the raised embankment/ berm around the lagoon – this is proposed to be removed as part of the lagoon refurbishment to provide more spill storage within the wide containment area. The local low point of the site is in the lagoon which is proposed to be deepened as part of the containment option to increase the sludge spill storage volume.

Figure 3-4 - Digital Terrain Model of Deephams Sewage Treatment Works

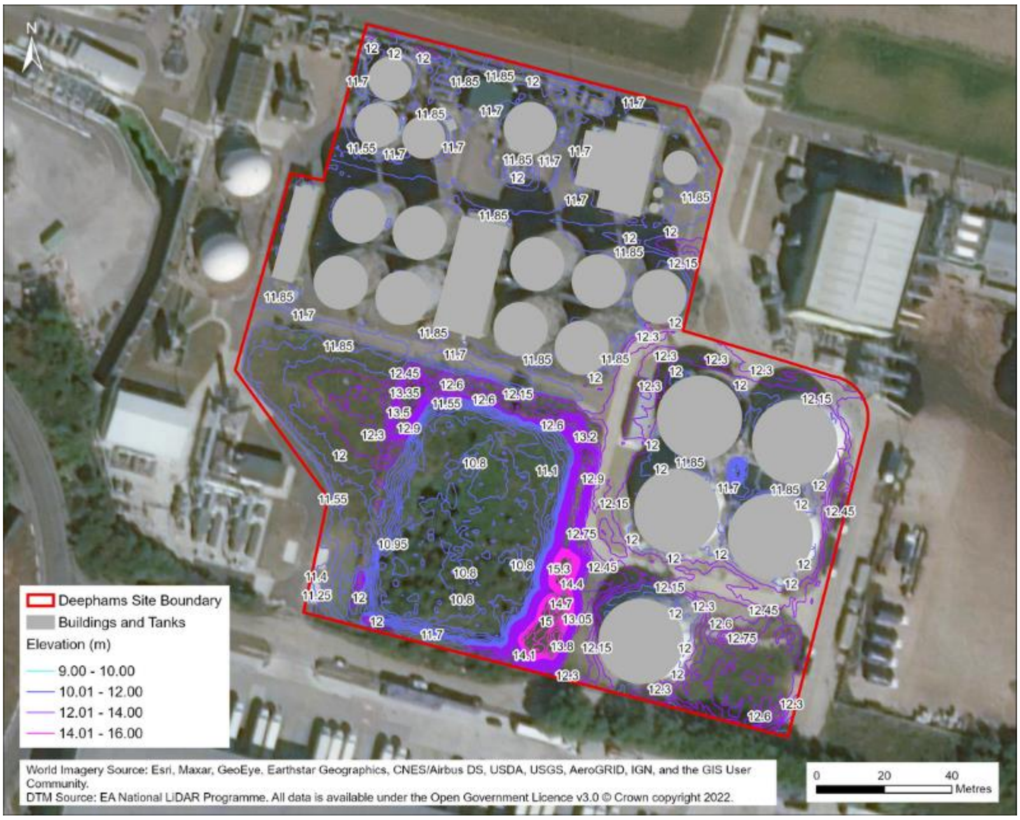

Figure 3-5 – Contour Plot of Deephams Containment Area

3.8 Operational constraints

Modelling shows that 10,297 m^3 can be stored within the bunded area shown by the red boundary in Figure 4.1. The intention is that spillage within will initially gravitate towards the lagoon area and only in extreme spill scenarios with the spill TWL rise above the lagoon and hinder access within the bund.

The existing ground surfaces are mainly grass and gravel and this will need to be replaced with impermeable surface e.g., concrete from which sludge can be cleared up easily. This is estimated to be TW operation have stated that it would be difficult to clean up sludge from gravel areas. The total impervious area to be replaced by concrete is estimated to be 7000 m^2. This is separate to the concrete lagoon lining required which will cover an estimated area of 4600 m^2.

The time to recovery and return site back to operation has been set at 3 days following direction by Thames Water. The containment volume, when not dictated by the 110% or 25% containment rules allows for three days of rain during the recovery period and one day of rain immediately preceding an event.

The sludge cake barn has not been included in the proposed containment area. Any spills onto the dried sludge cake would be difficult to clean up and take a long time, the sludge cake would need to be passed through a centrifuge again to dry it and re-thicken it or sent back to the head of the works.

3.9 Geotechnical and Environmental constraints

The refurbishment of the lagoon and surrounding area will need significant excavation and vegetation removal. The existing fill in this area will likely be unstable and contaminated and require specialist offsite disposal and treatment. The existing lagoon has been redundant for several years, but it is still a drainage pathway and is likely to present construction risks while excavating and installing concrete lining. Large built-up mounds surround the existing lagoon, (up to 2m above current road surface level), these are proposed to be removed to increase the spill storage withing the wide containment area.

According to Magic Maps the Deephams treatment plant is typically in an area with free draining lime rich loamy soils which are unlikely to present any site-specific geotechnical risks. With this said, it is known that the fill in the lagoon area is predominantly imported contaminated sludge.

3.10 Other constraints

There are waterways on both the west and east of the site, meaning that there are multiple spill receptors and pathways.

3.11 Design allowance for rainfall

Rainfall within the wide containment area for a 1 in 10-year return period events for the 24 hours preceding an incident and for a three-day period following an incident is estimated to total 1822 m^3. This is a significantly smaller volume that the 25% percent spill scenario and hence this figure has not been directly considered in the design of the bund area. The average 4-day rainfall depths for a 1 in 10-year storm for Deephams is 72 mm. It should be noted that the rainfall depths for Deephams 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 Deephams, 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 at Deephams STW are listed below:

- Re-commissioning (with refurbishment) the existing Lagoon area on site
- Bund/walls to contain liquid. The heights of bund/walls are the minimum heights required such that the top of the bund/wall is equal to the top water level plus 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. Containment ramps provide a barrier for the liquid on roads that still need to be accessible to vehicles for site operation. The maximum height of these will be 250mm to avoid issues with vehicle passage. The risk of spill at the ramps is mitigated by conveyance of the flow to site drainage and return to the head of the works.
- Local excavation around the lagoon of to increase the above ground storage area within the bund.

4.1 Containment Option1 Wide Area Containment and Lagoon Storage

One option was developed for containment on the Deephams site after input and agreement with Thames Water Operations representatives in a meeting on the August 4th, 2022.

This option utilises wide area containment in the permit area, which provides secondary containment to the sludge processing facilities. The usable containment area is approximately 25,311m^2.

The total spill volume is 10,297 m^3. That comprises of a catastrophic failure of one of 25% of all sludge tanks within the permit area. LiDAR spill modelling calculated the top water level (TWL) of this area to be at 12.09mAOD.

Figure 4-1 overleaf highlights the containment area for option 1.

Figure 4-1– Containment Option 1 – Wide Area Containment and Lagoon Area

Kerbing will be utilised around containment boundary and ramps constructed across roads to enable vehicular access. Maximum height of ramps and kerbing 250mm. The top of the kerb will incorporate a deflection profile that will reduce risk of overtopping immediately after a spill event and ensuring spill volumes remains within the containment area. Detailed design will assist with the final deflection profile to account for this risk. 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.

4.1.1 Bund Wall Height

The maximum bund wall height proposed in the critical spill scenario will be 1.09m (inc. freeboard) and will be along the southwestern side of the wide containment area. Towards the southeast of the site the bund height will be 0.25m (freeboard only) to act as a flow direction wall, the TWL of the spill scenarios are not expected to submerge this section of the containment wall due to the natural site topography grading west.

The relatively high bund wall heights mean that access along the western section will require flood gates as opposed to access ramps. This may have long term impacts on the traffic routes onsite to avoid entrances on the western bund wall which will require floodgates. The site road network offers the potential to establish new routine routes that allow the sections with floodgates to be used by exception and mitigates issues of floodgates being left open on heavily trafficked section.

4.1.2 Lagoon Characteristics and Drainage

The lagoon capacity is proposed to be upgraded to 6,014 m^3 capacity. The current proposal is to concrete line the lagoon. In detailed design it could be considered as a cost saving opportunity to research other lining techniques depending on groundwater levels and other ground conditions.

The natural topography of the site grades towards the existing unused lagoon. When the lagoon upgrades are completed (excavation and concrete lining) this area will harbour rainwater and site run off on an ongoing basis. For this reason, a small sump pump (~5kW) will need to be incorporated into the bund to periodically pump stormwater back to the head of the works based on a float operation system.

4.2 Mitigation of Site-Specific Risks

4.2.1 Jetting and Surge Flows

There is a low risk of jetting occurring as the majority of tanks are able to be practically set back from the boundary bund. The secondary and primary digesters on the west are unable to meet the minimum distance from the bund due to avoiding traffic impacts to the main site road. The western section of the site is a highpoint and any jetting spills in this area would likely drain to the southwest via natural topography.

Surge effects have been mitigated by the bund profile (recurved to return flows back on itself) and the distance of the bund wall to the tanks.

4.2.2 Flooding

According to the UK Government's Flood Map for Planning, the sludge area is only partially bordering some area classified as Flood Zone 2, as shown in Figure 5.2 overleaf. The Deephams STW, have a 1 in 100 to 1 in 1000 probability of river flooding. Mitigation measures may not be required, but probably only near places closest to the Pymmes Brook to the east and south.

Also, in the Flood Risk Vulnerability Classification sewage works are classified as 'less vulnerable,' if adequate measures to control pollution and manage sewage during flooding events are in place.

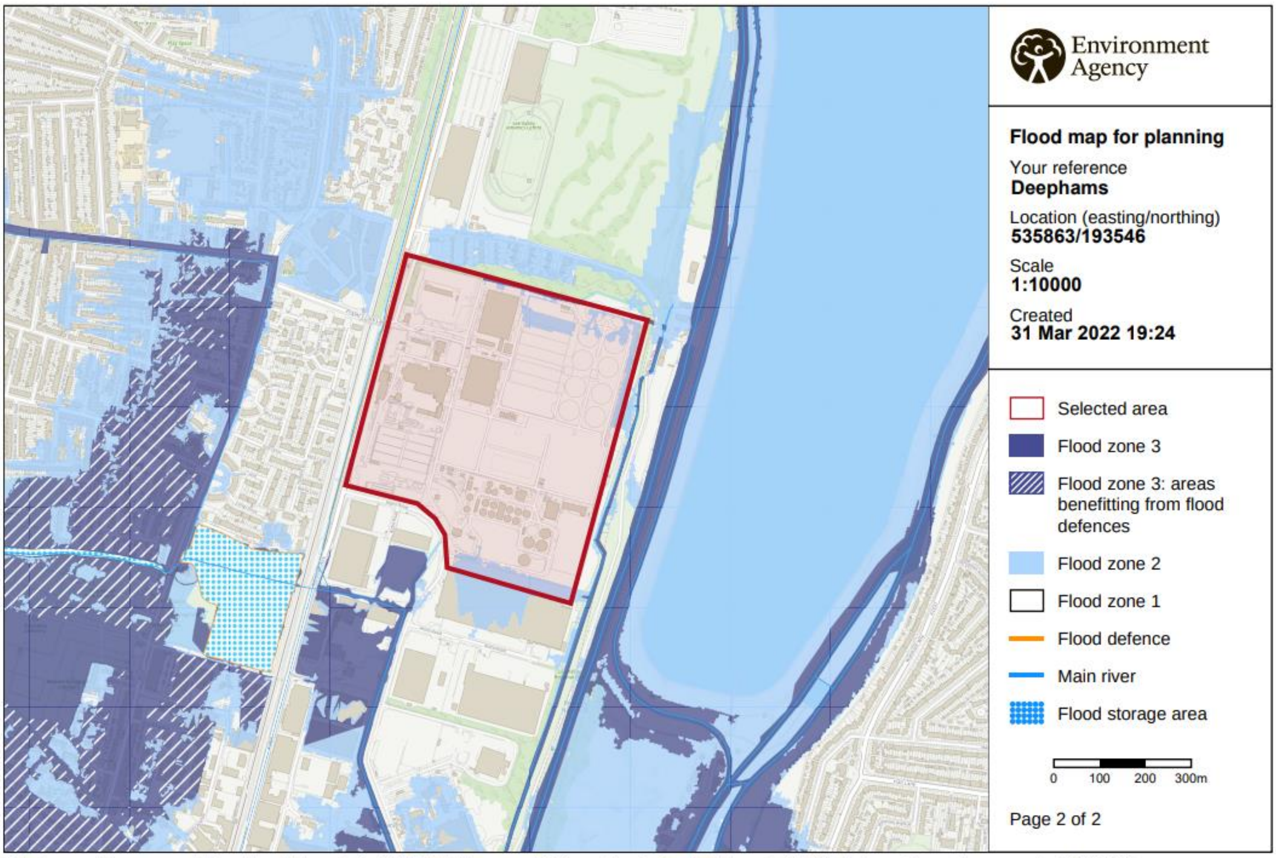

Figure 5.2 - Extent of Fluvial flooding in Deephams due to extreme weather events

4.3 Identification of Preferred Option

The preferred containment option is the wide area containment with lagoon storage. This is based on high flexibility and low site impact in small to minor spills (which can be contained entirely within the bund and not affect site access).

Other bund wall alignments were initially discussed with Thames Water but were ruled out, for example the empty space to the north of the primary digesters has been set aside by Thames Water for future site development.

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

- Excavation of the lagoon with difficult geotechnical conditions and potentially contaminated land.
- Fencing around the lagoon for safety reasons has been incorporated into the costing of this option, particularly to mitigate issues with a deeper body of water being masked by shallow standing water.

5. Site Drainage and liquor returns

5.1 Process flow diagrams

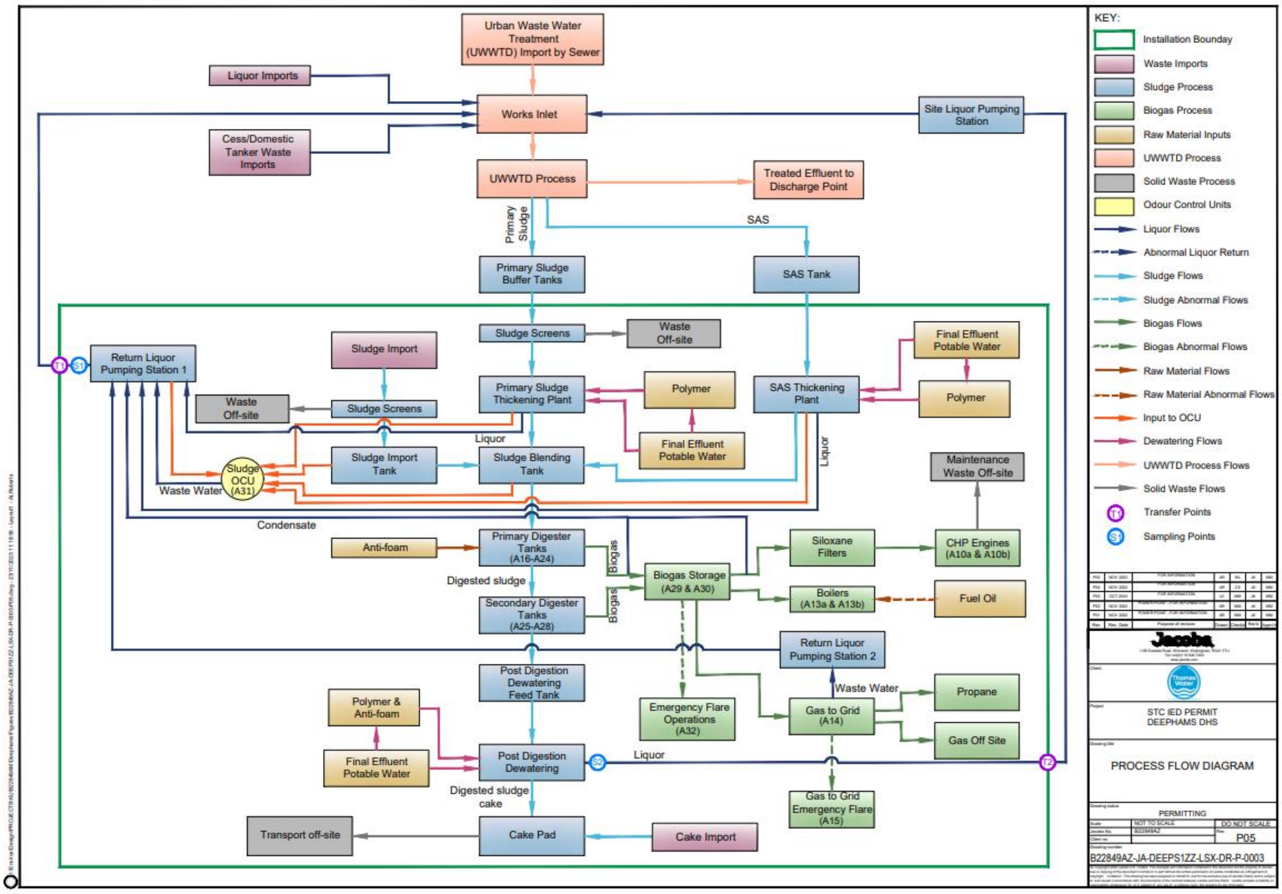

Figure 5.1 Process Flow Diagram

5.2 Foul, Process and Effluent Drainage

Site drainage assessments are based on Deephams Sewage Works Layout Plan Drawing Numbers DEEPS1ZZ-DPL-003.

The Sewage Works Layout Plan for Deephams shows all surface/ Combined/ Process/ Effluent drainage pipes within the containment boundary, indicated by blue lines going back to the head of the works shown in figure 5.2. In the event of sludge entering the head of the works, the shock load could adversely impact the sewage works treatment process. Therefore, in the event of a catastrophic loss of containment, this line should be isolated, or pumping should be inhibited to allow operations to manage the use of the available treatment capacity. For this site, the entire proposed containment area drains to the head of the work via one common pipe. As a result, only one manual isolation valve would need to be installed on the connecting drainpipe, to enable operators to isolate this drainage line in the event of a significant sludge spills that has the potential to overwhelm the head of the works.

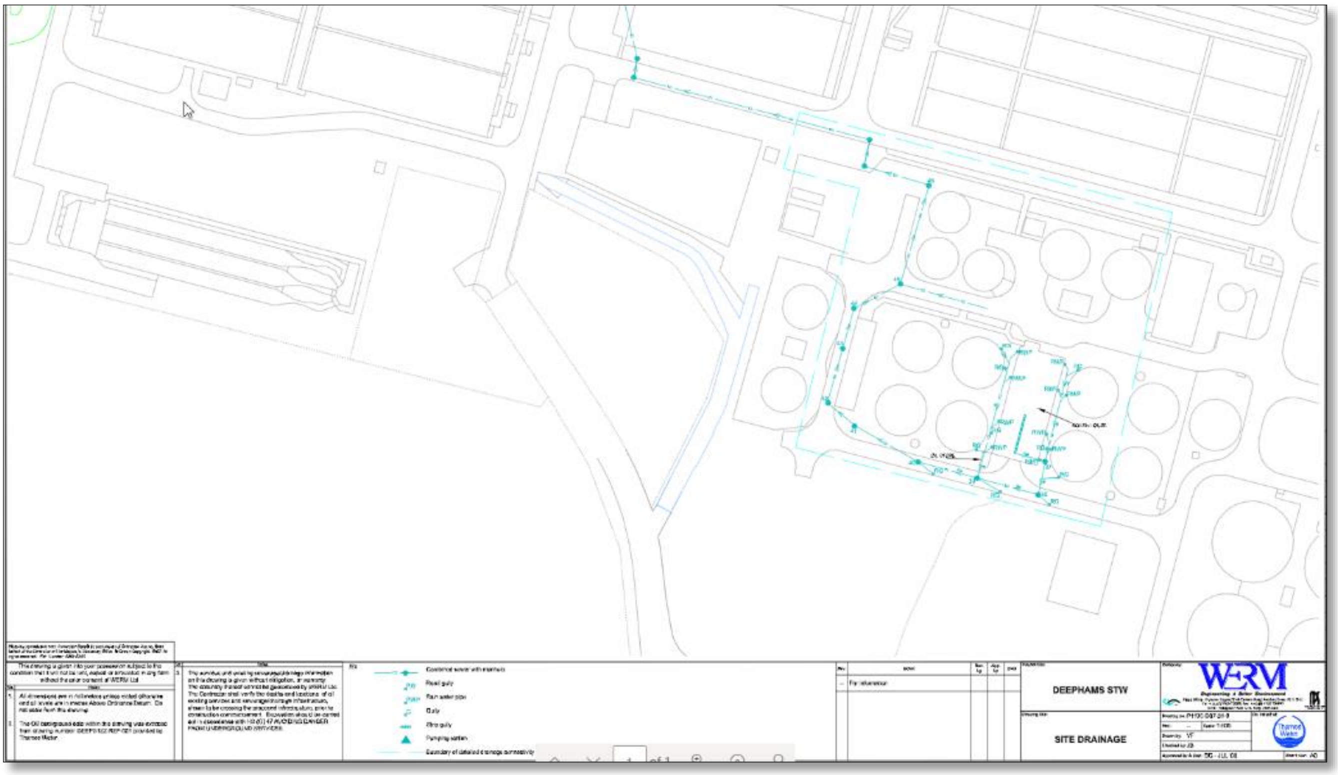

Figure 5.2 - Sludge area drainage - Deephams

5.3 Automatic Isolation Valves – Site Drainage and Tanks

For the catastrophic loss of containment scenarios for the Digester area 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 Didcot 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.

The proposed drainage pumping station in the containment lagoon can be inhibited when a failure alarm is generated. Operations then has the opportunity to run in hand to allow is use as part of the planned recovery actions.

6. Conclusions

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

Based upon the Anaerobic Digestion Bioresources Association (ADBA) containment assessment tool; the site carries an overall site risk rating of Medium meaning that Class 2 containment is needed.

This assessment focuses on site-specific risks and outlines the options available for providing secondary containment of a catastrophic tank or digester failure. The critical spill volume for this site has been identified as 10,297 m^3 which is the volume associated with 25% of all sludge assets on site. This value is significantly larger than the other two CIRIA scenarios including spilled tank plus rainfall and 110% of largest tank within Deephams.

One option was developed for sludge containment at Deephams STW – that of wide area containment with lagoon storage. This option constitutes of a bund wall with a maximum height of 1.09m on the southwestern section of the containment area. In addition, excavating and refurbishing the existing unused lagoon area will provide the initial storage area for sludge spills. Containment ramps will be constructed across the road crossings to the north and east of the area, whereas flood gates are required to be installed on the western walls due to the natural topography generating greater depths at these locations. In addition to the containment elements, the ability to isolate the singular containment area from the site drainage system will be required to mitigate the risk of unmanaged flows impacting the sewage treatment works.

Spills of less than 50% of the critical volume (which includes 110% of the largest tank volume) can be entirely contained within the lagoon which provides operational flexibility in managing the clean-up operation.

The contained spill modelling shows that the water level within the containment bund of spill would be a maximum TWL of 12.09m. Replacement of permeable surfaces is required and the use of an impermeable bound-surface material will minimise clean-up time and effort.

Freeboard allowances and the profile of the containment bund wall provides mitigation against surge effects. Jetting escape and surge flows are predominantly mitigated by distance from the bund, some risks exist on the eastern section of the site due to space constraints.

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

A summary of the hazard risks for Deephams STW are as follows:

Source – There are two sources that have been identified:

1. The principal driver for the High determination is the presence of sludge digestate.
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 – There are three principal receptors:

1. River Lee Navigation Canal and William Girling Reservoir bordering the site to the east, with links to the remaining Lee Valley reservoir abstraction points downstream.
2. Pymmes Brook and Salmons Brook adjacent to the STW in the southwest and east.
3. Ardra Road Industrial Estate including a Lidl distribution warehouse directly south of STW.

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

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.