Jacobs

J840 – STC IED Containment

Crawley STC – 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 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 Crawley.

Crawley STW serves a population equivalent of 139,000 taking in sewage from Crawley and Gatwick Airport. The sludge treatment centre shares the same site as the sewage treatment works.

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.

Crawley holds some 6,413m³ of liquid within the sludge treatment centre. The liquid sludge is stored in 12 tanks with individual volumes varying between 9 to 1651m³ and the majority of the tanks are concrete. The site is generally low lying and gently slopes towards the southern border. The containment volume of 3017m³ is driven by the largest tank volume plus rainfall volume within the containment area rather than the 25% rule (25% of total tank volumes which includes allowance for rainfall) or the 110% (of the largest single tank) of the total tanks volume. The STW when constructed in early 2000's with a bund around the STW and this will act as tertiary containment.

Two wide area options for containment have been identified and reviewed with Operations to confirm that the working of the sewage treatment works and Gatwick Airport operations are not compromised by proposals:

1. Wide area containment whereby the sludge tanks are contained within a bunded boundary with sufficient area to generate depth that does not deny emergency access to equipment when the spill has been contained.

2. Increased the wide area containment area utilising the available land on site, whereby the sludge tanks are contained within a bunded boundary with sufficient area to generate shallow depth that does not deny emergency access to equipment when the spill has been contained.

Refer to Section 4.1 for details on the options reviewed and Section 4.3 for the preferred option.

Containment Area	Containment Design Description
Containment area parameters	• Sludge tank area naturally slopes towards the southern border of site. Due to the high density of tanks and plant, there is no scope to be able to reprofile the area. • The top water level from the modelling results is 61.94mAOD and the lowest point along the containment boundary is 61.04mAOD.

Wide area containment	• Considering the parameters, the concrete bund walls proposed consist of 280m length and of height 1.15m including freeboard allowance, will be constructed along the southern containment border*. • The walls will tie into higher ground where the southern border meets the east and west containment boundary. At these points, the bund height plus freeboard dictates a height of 300mm. • The cake barn will be utilised as the containment boundary so the 300mm bund will tie into this. • In addition, the gas holder to the east of the THP plant is raised on an existing concrete raft. This provides existing containment protection to jetting from the THP reactors to the west and is approximately 300-500mm high. This wall will be reinforced so not to compromise the gas bag raft but no additional 300mm bunding will be constructed here.
Containment area access	• 3 large ramps will provide access for vehicles as area is frequently visited during the day. • 3 sets of steps will be provided around the low bunding areas for pedestrian access. • A large flood gate (2m length x 0.75m height) will be installed across the inlet pumping station entrance on the south-east border of the building, to protect the pumps in the basement from flooding. The existing ground level here is 61.4mAOD. • 2 large flood gates will be installed at the existing control room and laboratory (2m width x 1.15m height). This building will house future Scada equipment and is considered high sensitivity to flooding. • Any jetting spill that is not contained by the ramps will be diverted back to the head of the works by the drainage network. This is particularly significant on the north west ramp where there is only a freeboard allowance of 50mm.
Sludge dewatering plant local containment	• 300mm local bunding will be provided around the sludge dewatering plant to manage relatively low spill volumes compared to the main containment area. • Steps will allow easy pedestrian access to the dewatering plant area.
Summary	• Option 1 reduces impact to operational access as no containment boundaries interfere with frequently utilised access roads. • Minimal additional infrastructure and project cost by utilising existing bunding along the southern border.

Table 1 below provides a summary of the preferred option:

Containment Area	Containment Design Description
Containment area parameters	• Sludge tank area naturally slopes towards the southern border of site. Due to the high density of tanks and plant, there is no scope to be able to reprofile the area. • The top water level from the modelling results is 61.94mAOD and the lowest point along the containment boundary is 61.04mAOD.
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	• Minimal additional infrastructure and project cost by utilising existing bunding along the southern border.

Table 1 – Summary of the preferred option

*There is scope to reduce the bund height in detailed design to follow natural ground level where the flood depth is lower than 0.88m.

In addition to the creation of bunds, which due to space constraints are likely to be formed from concrete, 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 four-day recovery period. At Crawley, there are relatively small areas of grass within the containment area that will require resurfacing.

Vehicular access into the containment areas is by ramps (speed humps) restricted to nom 250-300mm in height; traffic movements on site make the use of permanent flood gates impracticable. Whilst the site is identified as requiring Class 2 containment (impermeable soil with a liner), the proposed solution is intending to concrete (with no liner) on the basis of the impermeability of the concrete, inherent strength and long-term mechanical resistance.

The containment volume identified reflects the potential escape volume from the tanks and the 1-in-10 year rainfall that could arrive during the clearing up period.

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. There is the potential for some flow to overtop the access ramps during the conditions of the initial burst which is addressed by tertiary containment and conveyance to the site drainage system which returns flow to the inlet works.

The general layout of the proposed solution is presented below:

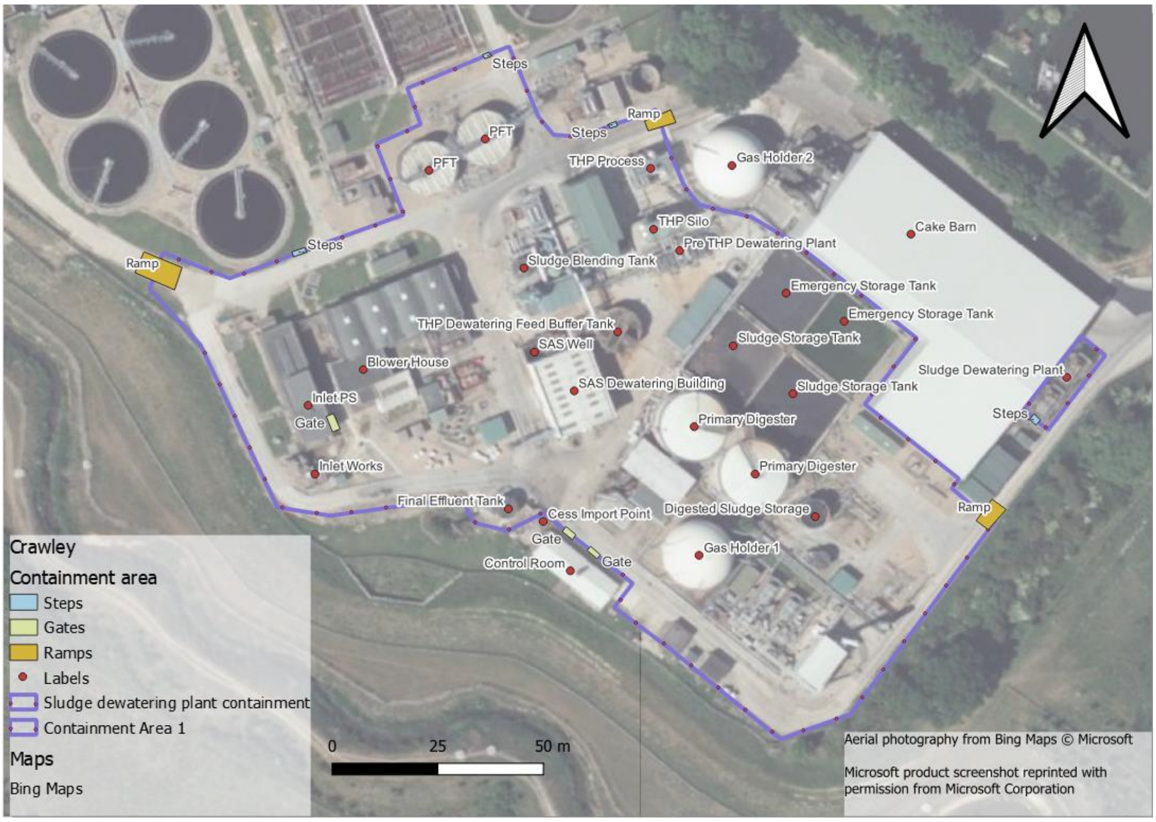

Figure 1-1 - General layout of containment for Crawley STW

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 remote 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 at Crawley and outlines the options available for providing remote secondary containment in the event of a catastrophic tank or digester failure.

The current assessment identified gaps between the existing conditions of the sludge assets in Crawley 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 Crawley STW were identified through a desktop study, Light Detection and Ranging Analysis (LiDAR) analysis and a site visit.

Crawley sewage treatment works (STW), Figure 2-1 below, is located approximately 5 km north-east of the town of Crawley, West Sussex and close to London Gatwick airport. Directly 30m west of the site boundary is a railway and a further 70m from the railway is the A23 road. To the north of the site is an area of woodland and car parking associated with London Gatwick Airport while to the east is a balancing pond and further woodland and greenspaces. To the south is green space and the Radford Road, which is a residential road. To the west of the site is the Southern Train railway line and a commercial business park. The STW treat sewage from the town of Crawley and Gatwick Airport, with a population equivalent of approximately 139,000.

Figure 2-1 shows the Boundary of the permitted IED area and the assets contained within Crawley STW.

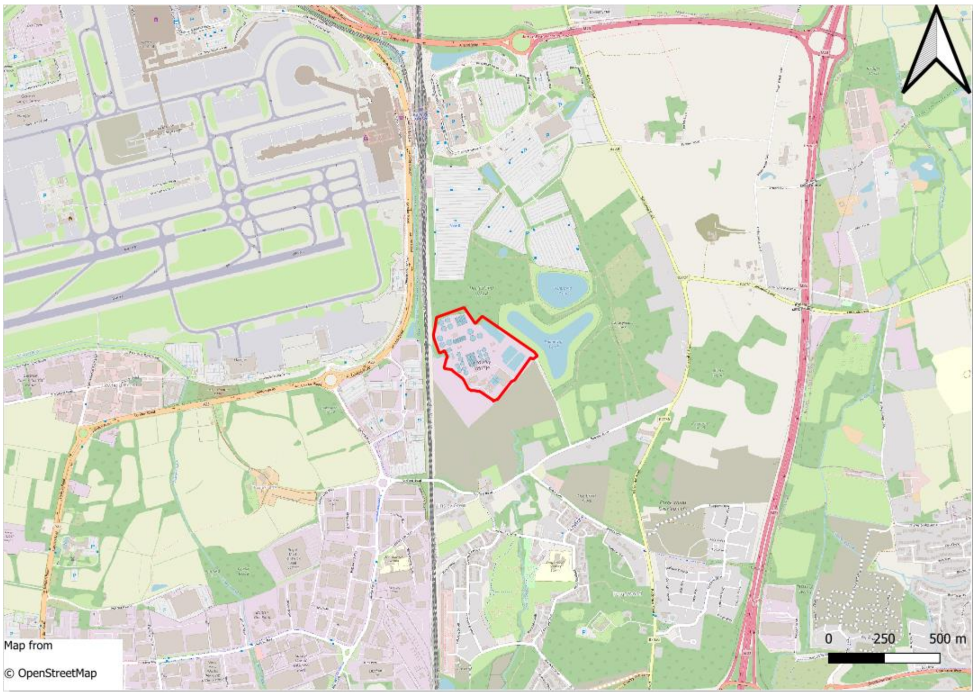

Figure 2-1 - Location Plan Crawley Sewage Treatment Works

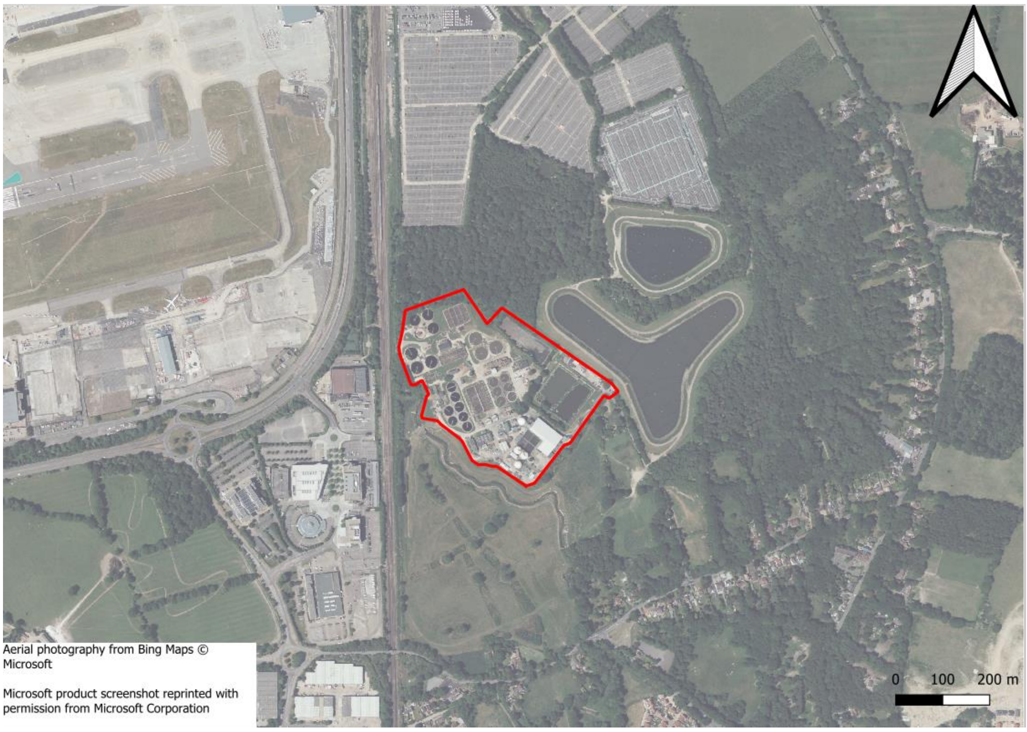

Figure 2-2 - Satellite view of Crawley Sewage Treatment Works

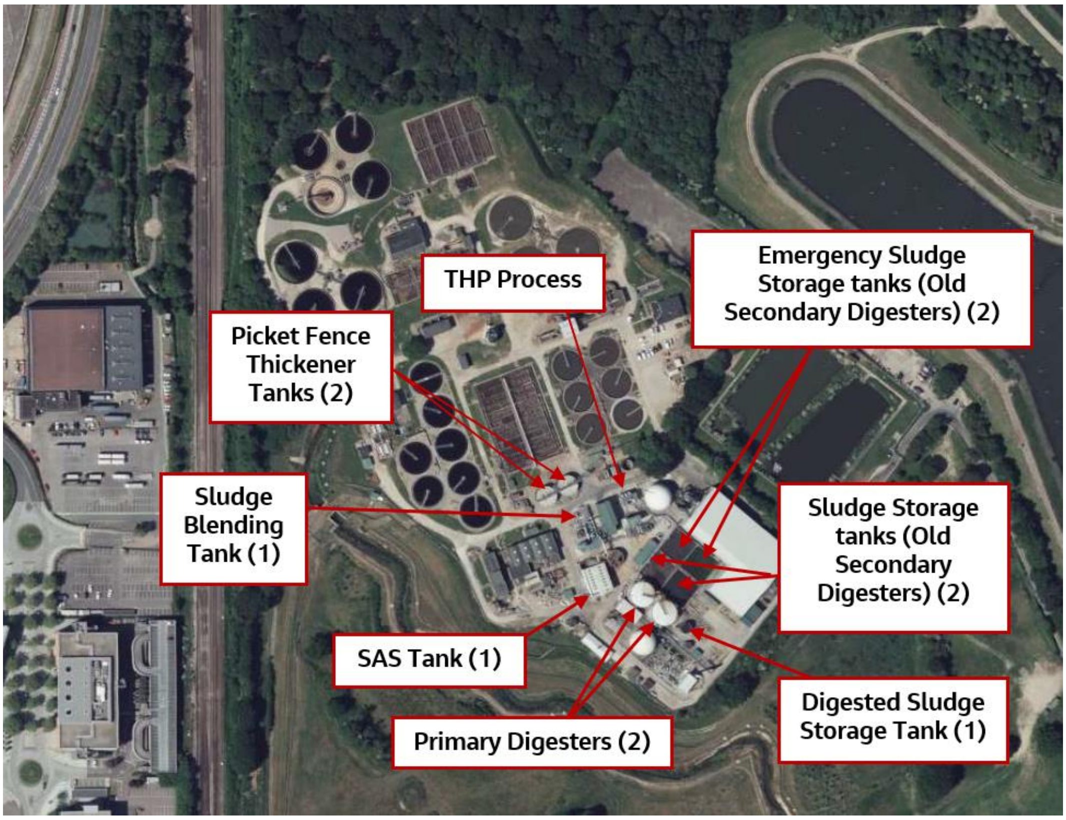

Figure 2-3 - Crawley Sewage Treatment Works – Digester Area plan

This document should be read in conjunction with; Crawley STW, Risk Identification and Containment Assessment Report, revision OA dated 19/05/2022. This report outlines the impact of an uncontained spill and the risk assessment completed.

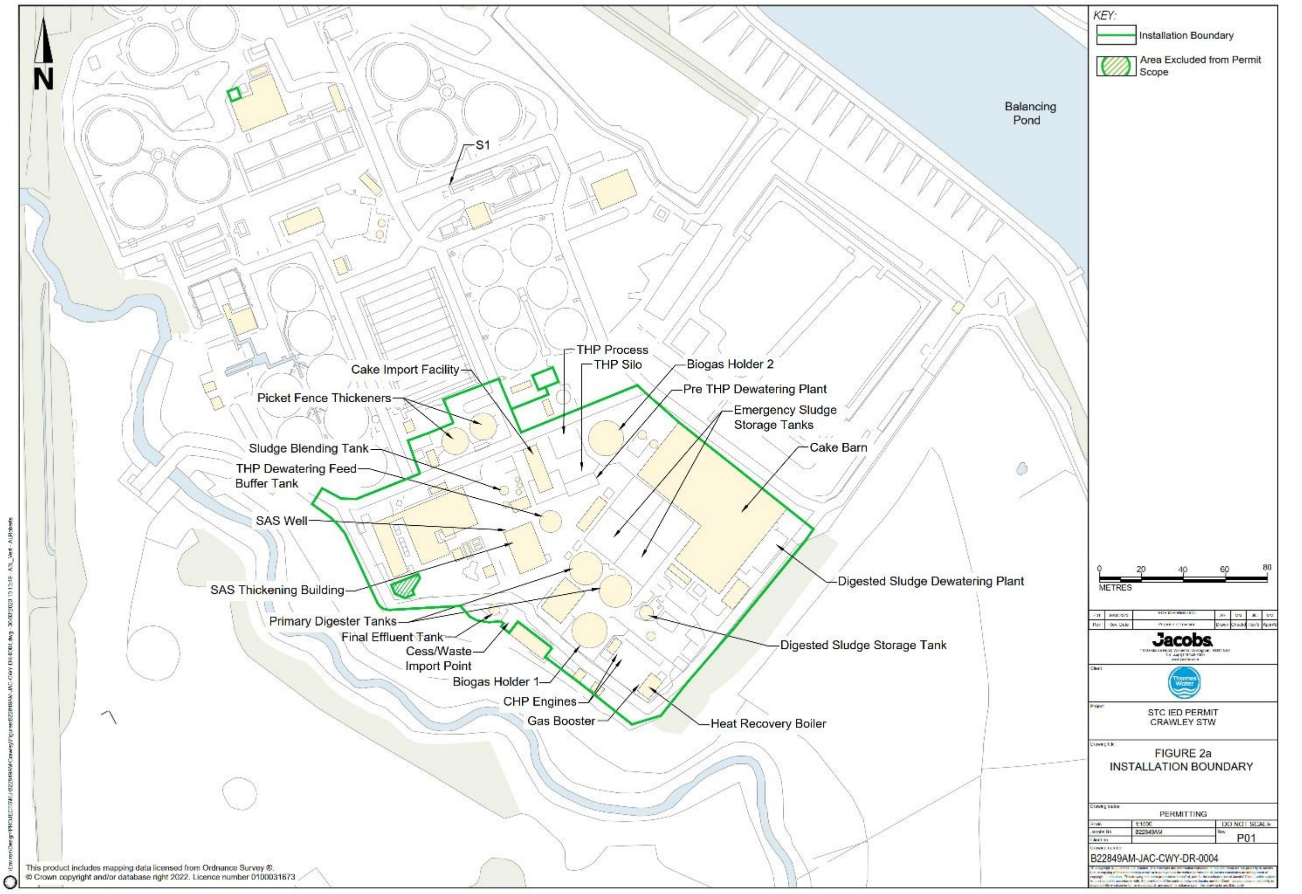

Figure 2-4 - Boundary of the permitted IED area and the assets contained within Crawley STW.

3. Proposed Containment at Crawley 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;

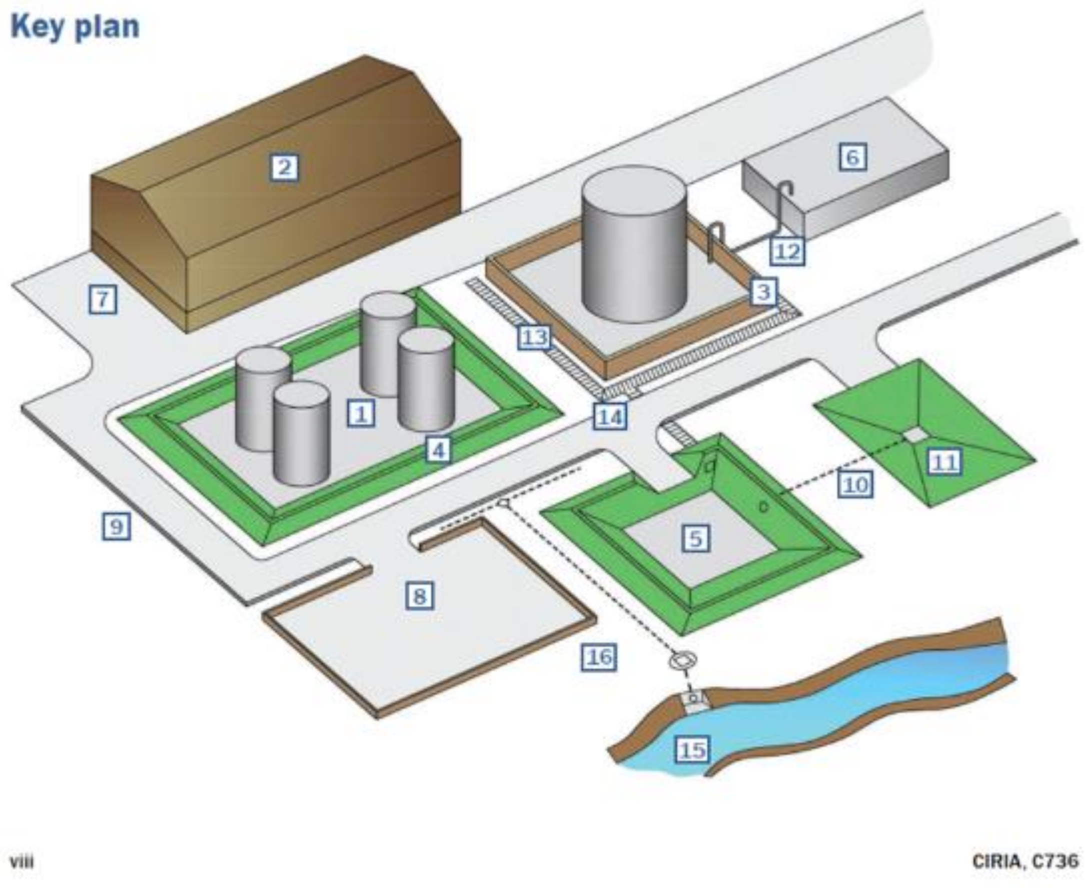

Figure 3-1 - Diagram of primary, secondary and tertiary containment examples

-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 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 remote 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 remote secondary containment

The objectives of the remote 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 pumped back to the inlet of the sewage works in an uncontrolled manner.

The remote secondary containment will be provided by maximising the use of existing impermeable surfaced areas to provide a fail-safe passive system that relies on gravity rather than pumps. A means of leak detection that will automatically trigger isolation valves at key locations in the drainage system is also proposed.

3.2.1 Uncontained Spill modelling

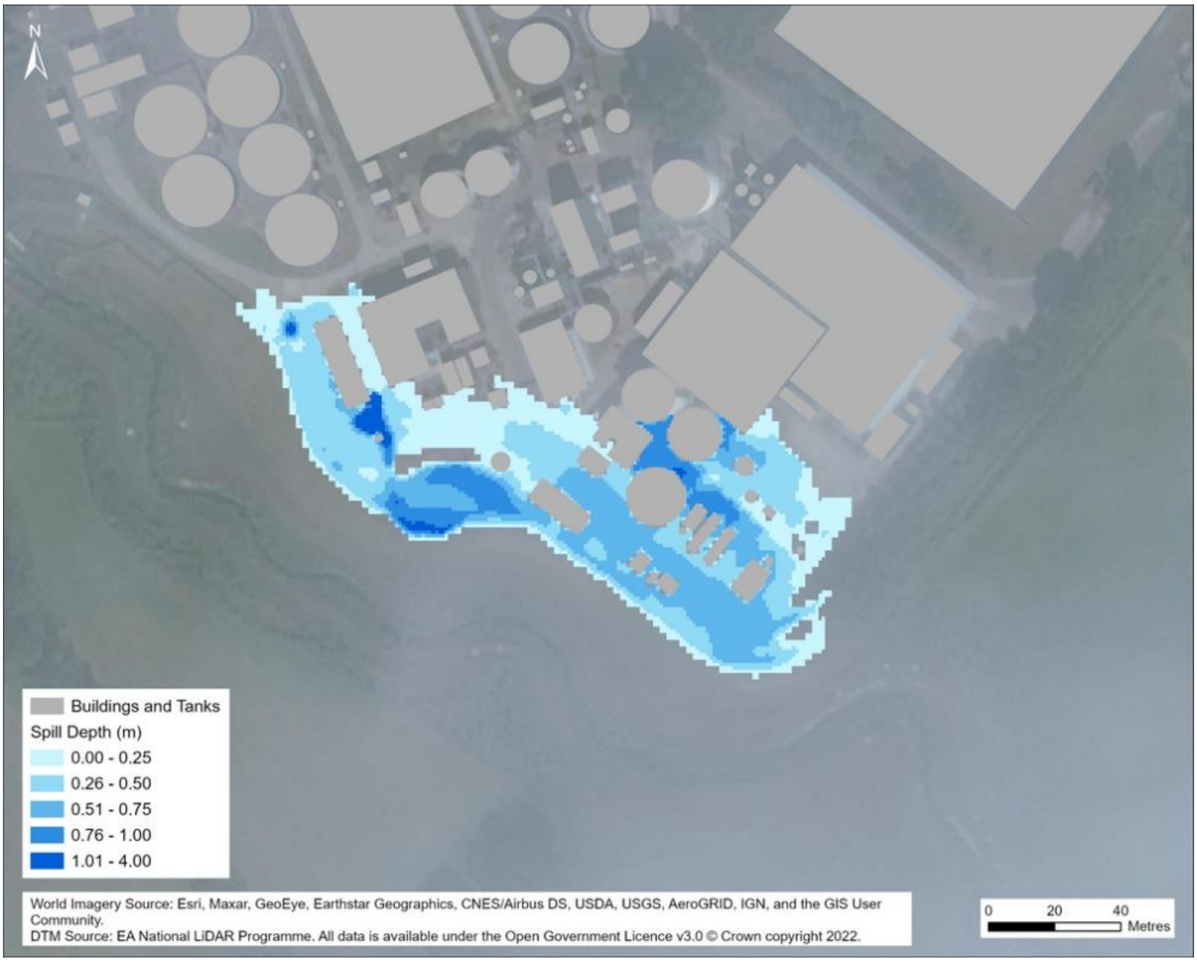

Figure 3-2 - Uncontained Spill Model Results

As seen from Figure 3-2, the sludge spill mapping of an uncontrolled event in Crawley STW shows that a potential sludge spill from the one of the primary digesters will be self-contained within the site and therefore passive containment does not need to be implemented to safeguard the nearby receptors. According to the model the spill will run southwards initially then westwards in approximately 3 minutes after the failure of one of the digesters.

The spilled sludge will initially travel southwards from the secondary digester pools, the point of rupture, surrounding the primary digesters and the digested sludge storage tank. The sludge will then travel west, through the cess/waste import point, which explains the high velocity of sludge at this point, then surrounding the SAS dewatering building, here is where the sludge travel terminates.

3.3 Site Classification Crawley

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

Table 2 – ADBA Risk Assessment rating

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

Refer to appendix 1 for summary of the ADBA risk assessment tool.

3.3.1 Spill Volume Summary

There are two components that contribute to the required capacity of secondary containment, the source spill volume requiring containment and rainfall. Section 4 of CIRIA 736 forms the basis of this assessment. Section 4.2 reviews current industry practice relating to source spill volume, section 4.2.8 then summarises current industry practice relating to source spill volume in a tabular form. It can be seen from section 4.2.8 that sewage sludges and associated regulations / guidance are not listed.

Within section 4.2.1 there is detailed reference to the use of the largest tank plus rainfall, 110% of the largest tank or 25% of the total tank inventory volume, whichever is greater, and the rationale for this. CIRIA recognises that this approach is not quantitative or based on a risk assessment and are arbitrary methods. Section 4.3 and 4.4 provide guidance on a quantitative risk assessment methodology and this is what is being used for the calculation of the required capacity for containment in this report.

3.3.2 Total Spill Volumes

The containment volume has been checked against the largest tank plus rainfall, the 110% and 25% rule.

The total design contained volume comprises:

1. Wide containment area: 3017m^3

Table 3 - Estimating critical spill volumes

Wide containment area		
25% Rule	1603	
110% Rule	1816	
Largest + rainfall	3017	Emerging critical case

3.4 Crawley STW Summary of Containment volumes and assets

3.4.1 Assets for Containment

The tanks for which containment is required are summarised below:

Table 4 – Tank list summary and associated volumes

Tank Purpose	No.	Operational Volume (m^3)	Total Volume (m^3)	Material
Picket Fence Thickener	2	522	1044	Concrete
Primary Digesters	2	1651	3302	Concrete
Sludge Blending tank	1	59	59	Concrete
Digested Sludge Storage tank	1	177	177	Steel
Sludge Storage tanks (Old Secondary digesters)	2	680	1360	Concrete
THP Steam Reactor tank	3	9	27	Steel
THP Dewatering Feed Buffer Tank	1	448	448	Concrete
		Overall Total	6413	

3.4.2 Digital Terrain Model

The terrain model (Figure 3.3) shows that at Crawley STW, the digesters are on lower ground relative to the north and on higher ground relative to its south, therefore the spilled sludge would flow down towards the south and southwest direction.

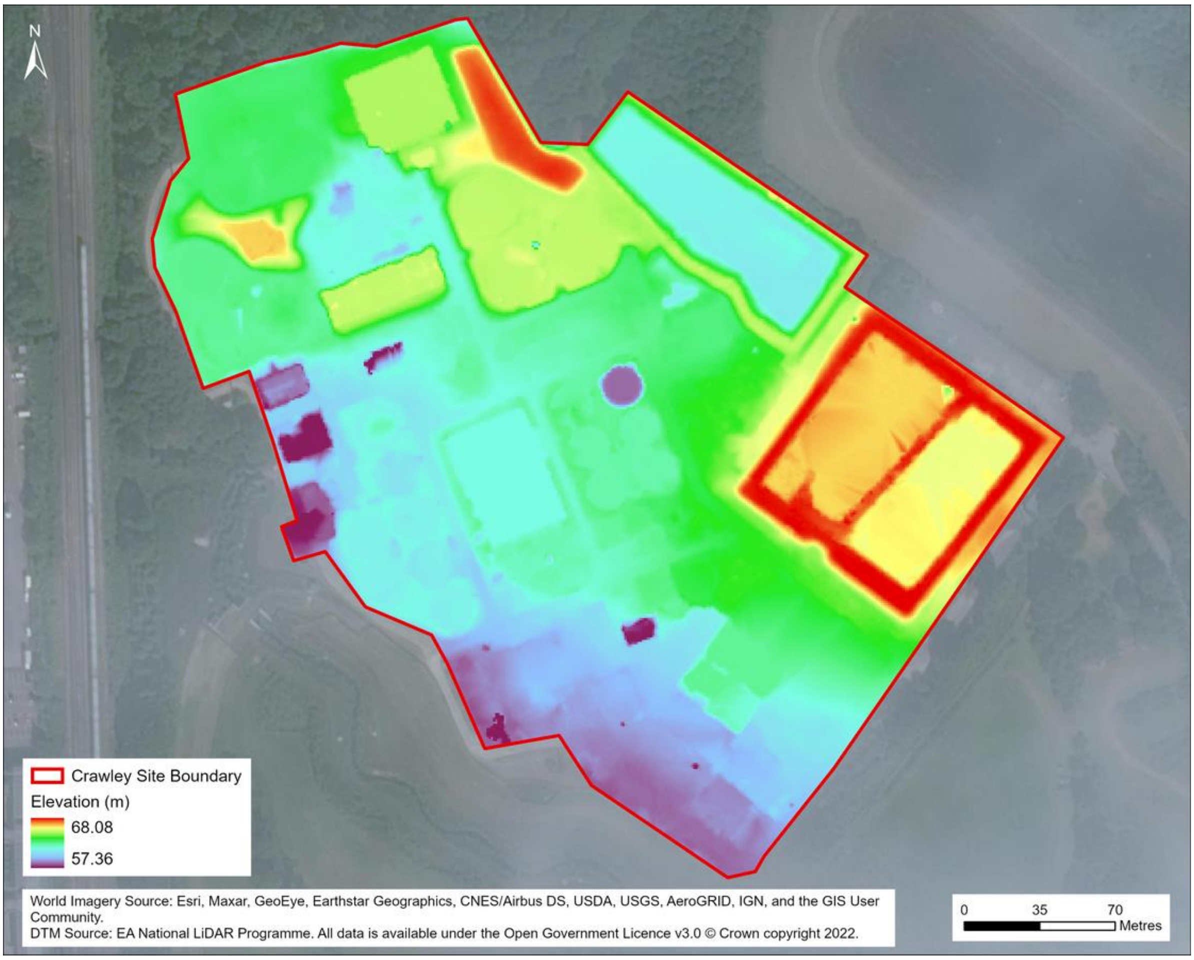

Figure 3-3 - **Digital Terrain Model of Reading Sewage Treatment Works**

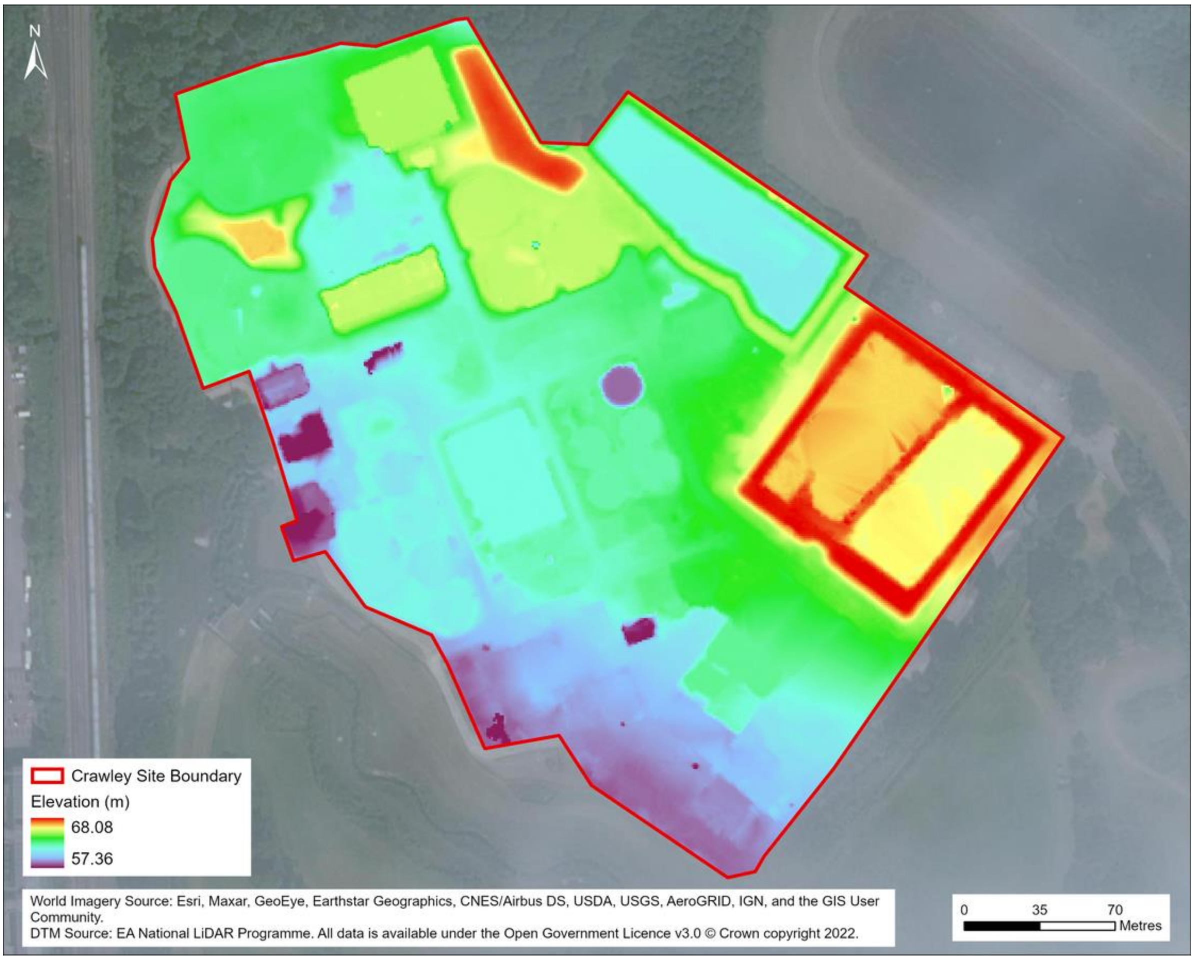

Figure 3-3, the sludge spill mapping of an uncontrolled event in Crawley STW shows that a potential sludge spill from the one of the primary digesters will be self-contained within the site and therefore passive containment does not need to be implemented to safeguard the nearby receptors. According to the model the spill will run southwards initially then westwards in approximately 3 minutes after the failure of one of the digesters.

The spilled sludge will initially travel southwards from the secondary digester pools, the point of rupture, surrounding the primary digesters and the digested sludge storage tank. The sludge will then travel west, through the cess/waste import point, which explains the high velocity of sludge at this point, then surrounding the SAS dewatering building, here is where the sludge travel terminates.

3.4.3 Contained Model Output and Contour Maps

Figure 3-4 - Contour map of the contained area

Figure 3-5 - Contained model output

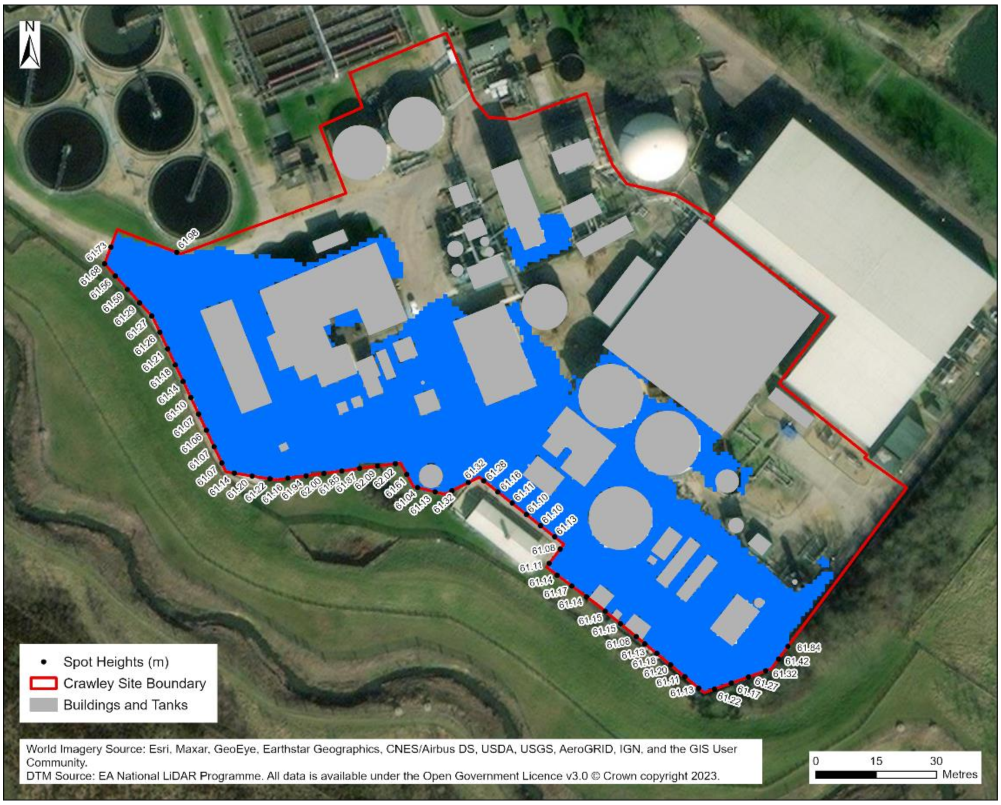

Figure 3-6 - Contained model output showing ground elevations at boundary

Table 5– Levels associated to each containment area

Area	Top Water Level (mAOD)	Lowest Spot Height (mAOD)	Maximum Depth against boundary wall (m)	Height of containment area (mAOD)*
Wide area containment	61.94	61.04	0.9	62.19

*Height includes freeboard allowance.

Table 5 above compares the top water level with the lowest spot height from the modelling results. The maximum depth against the boundary wall is then calculated to more accurately reflect the spill depth as any spill will flow towards one boundary of the containment area and will not be evenly distributed across the area.

It also shows the proposed height of any containment bunding according to the top water level. The containment bunding is set by adding 250mm to the top water level to provide freeboard to prevent overtopping from the surge effects.

Please note that these values are derived from 1m LIDAR data which has an accuracy of +/- 150mm.

3.5 Identified Constraints

3.5.1 Operational constraints

3.5.1.1 Clean-up time

The time to recovery and return site back to operation has been set at 4 days which aligns with the CIRIA guidance maximum as Thames Water operations state they cannot achieve this in a significantly shorter time, e.g. 48hrs.

3.5.1.2 Surface cleaning

The existing ground surfaces around the sludge treatment tanks consist mainly of grass and gravel that will need to be replaced with an impermeable surface, such as concrete, to facilitate the cleanup. The impermeable surface will be gently sloped to aid with the sludge spill flow path towards the drainage network.

It is noted that concreting these areas may slow emergency access to underground surfaces and there is a trade-off between the advantages of digging up existing surfaces (in grass or gravel) vs. decreasing the clean-up effort required in the event of a sludge spill.

Whilst the site is identified as requiring Class 2 containment (impermeable soil with a liner and leakage detection system), the proposed solution is intending to use concrete (with no liner) based on the impermeability of the concrete, inherent strength, and long-term mechanical resistance. Remedial works to existing concrete slabs/roads will be undertaken to ensure that they provide a competent surface, for example resealing of joints.

3.5.1.3 Access and Traffic Thoroughfare

Vehicular access through the flow guiding walls will be via ramps (speed humps) restricted to nom 300mm in height and 1:15 slope.

A flood gate has been included at the existing entry point into the inlet pumping station to protect against flooding of the pumps in the basement of the building. 2 further flood gates at each existing door will be installed along the southern containment boundary for access into the current cess import and laboratory building.

To allow access on foot, steps with handrails will be constructed to allow workers to traverse the walls where access is required. Refer to Figure 4-1 for an illustration of the pedestrian access to these areas.

3.5.1.4 Existing Services

Several above ground pipes can be seen from aerial images which may need to be relocated during construction/excavation.

3.5.2 Geotechnical and Environmental constraints

Ground conditions need to be considered during excavating and backfilling activities.

Regarding the construction works, there are no significant environmental constraints as these will all be completed within a Thames Water site.

The existing shrubbery within the containment area shall be removed and area infilled with concrete. To compensate for the loss of shrubbery, alternative areas shall be identified onsite for compensation planting or planting containers installed onsite.

3.5.3 Other constraints

The constraints with the interface between Crawley STW and Gatwick Airport flows is mitigated by an existing penstock at the connection to the treatment works. The penstock automatically closes in situation where Crawley STW is not operational. The flow is redirected and flood the open land surrounding Crawley STW. There has been 1 scenario previously on site where the penstock was activated and the land to the south of the STW, safely flooded whilst the treatment works was brought back to operation. Operations on site have confirmed the existing resilience to mitigate any risk to Gatwick Airport and their normal operations.

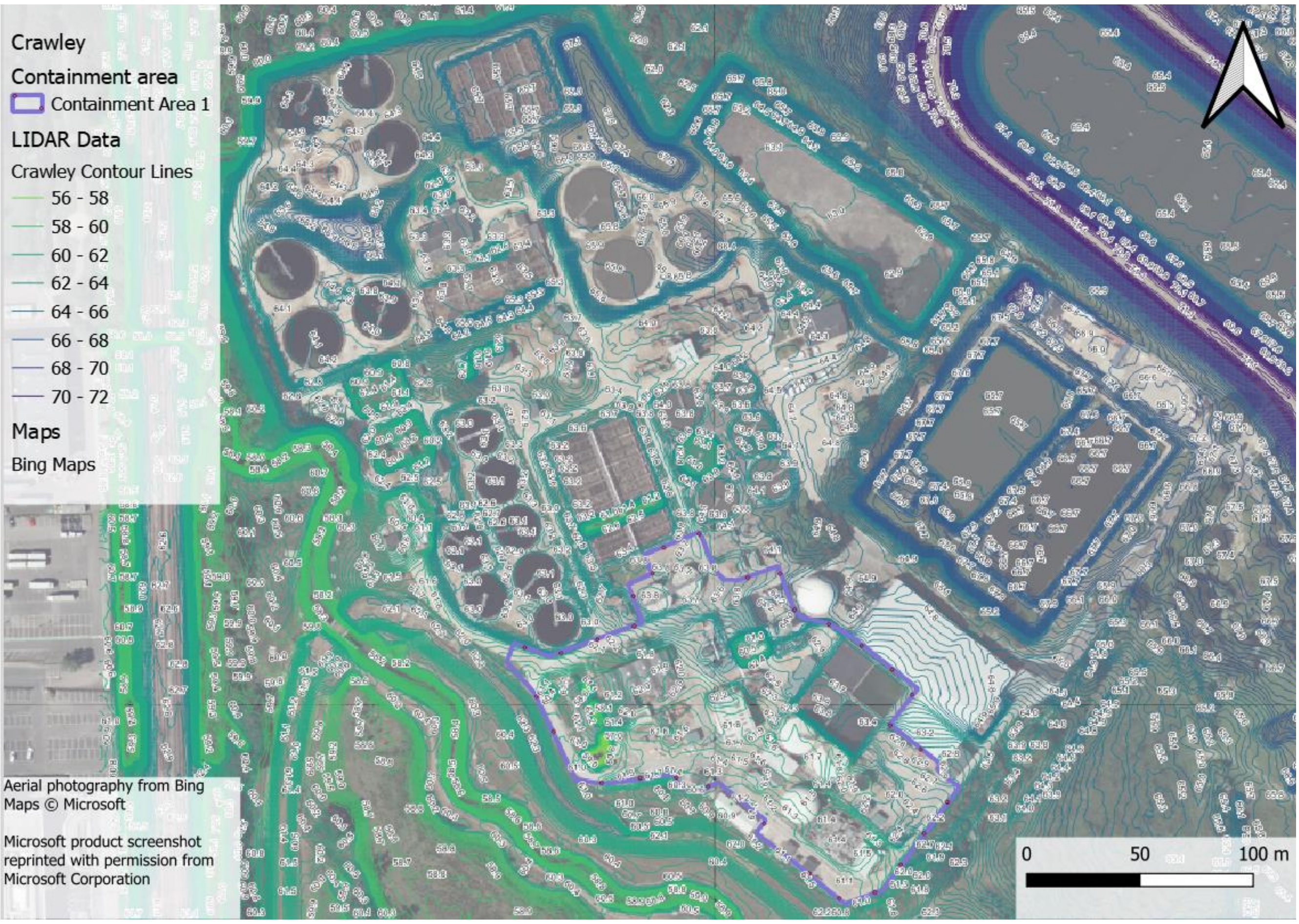

Figure 3-7 - Map of Crawley STW showing areas where natural environment will be disturbed

3.6 Design allowance for rainfall

In addition to the maximum volume arising from a credible failure scenario, 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 a four-day clean up period following an incident. The arising average rainfall depths for a 1 in 10-year storm over the event period for Crawley is 87.10mm. It should be noted that the rainfall depths for Reading 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.

3.7 Planned Site Upgrade

Thames Water Operations noted minor upgrades to the site including new SCADA equipment in the existing cess import area and laboratory building.

- Containment construction as part of the preferred option may interfere with planned upgrades and connections. The interference is only likely to occur during construction if they are planned around a similar time.
- The planned construction of major storage assets could potentially be combined or repurposed with sludge containment construction for a more cost-effective solution, but at this point the containment proposals seek to avoid sterilising areas with potential to accommodate new construction.

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

- Bund/walls to contain liquid. The heights of bund/walls given in Section 4.1 are the minimum heights required such that that 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. Along some areas of containment, there is existing raised levels including a concrete wall in the south-east corner. The integrity of the wall and other existing features will need to be assessed before utilising them within the containment boundary.
- 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 250-300mm 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.
- Steps will provide a containment barrier and allow access in and out of the containment area where foot traffic is high, but vehicular access is not needed. These steps will have handrails to facilitate safe passage over them.
- Local infill of grass/gravel to create an impermeable surface and facilitate containment and conveyance.
- Raised kerbs on roadways to channel spill to the remote containment area.
- All buildings within the containment and transfer areas must either have doors that lie above the top water levels detailed in Section 4.1 or any equipment inside must be raised off the ground to level above the top water level.

4.1 Containment Options

Two options were investigated and developed with operations. The preferred option considers a close containment solution for 1 wide area. Table 6 provides a summary of Option 1.

4.1.1 Containment Option 1 – wide area containment approach

Table 6 – Summary of the preferred containment option

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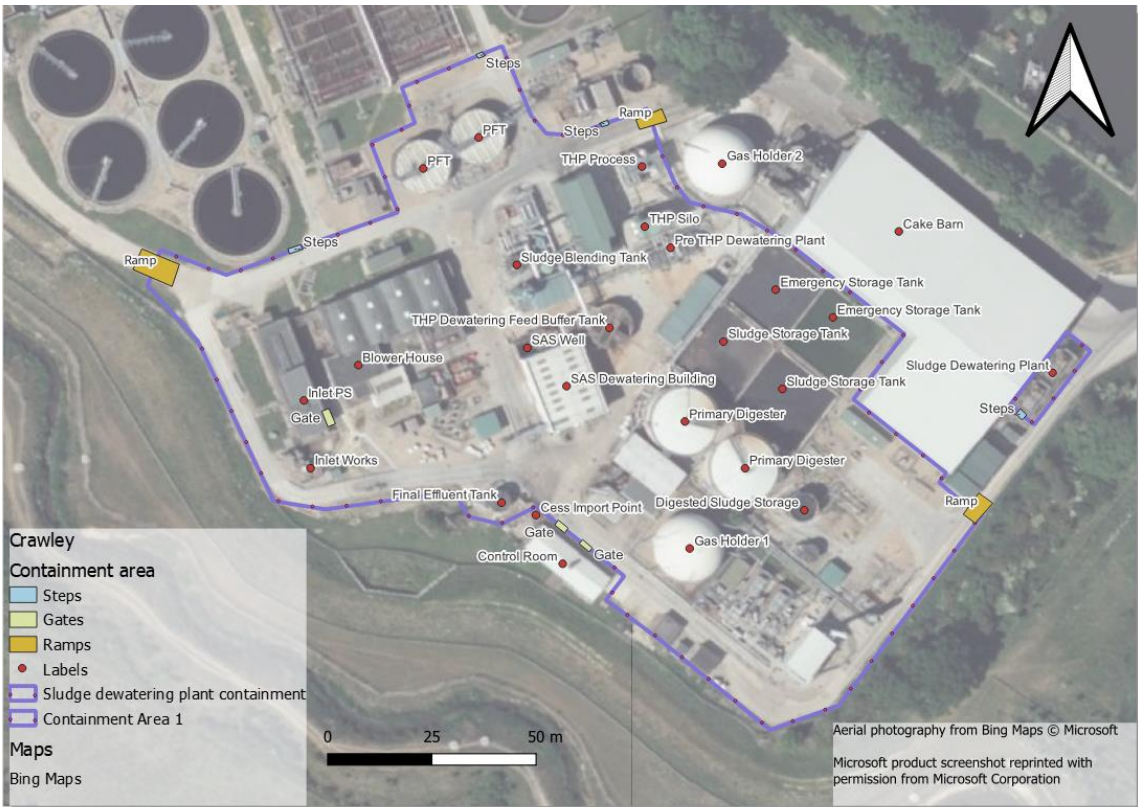


Figure 4-1 – Containment Option 1 – Wide area containment option

4.1.2 Containment Option 2

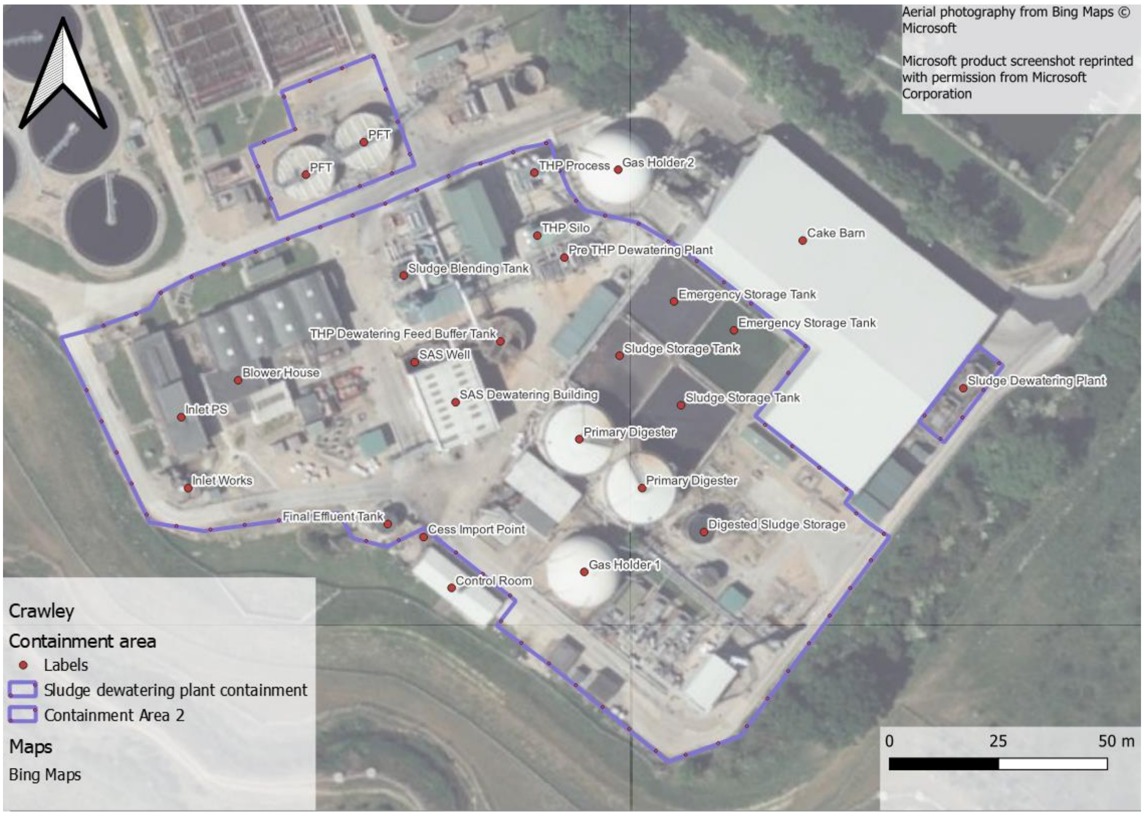


Figure 4-2 – Containment Option 2 – Wide area containment option

Option 2 in Figure 4-2 comprises of a wide containment area that encompasses all the recorded sludge tanks. This option was discussed with Thames Water Operations and ruled out as operatives preferred minimising obstructing site operations and maximising the use of the disused digester tank.

Bunds will be utilised around containment boundary and ramps constructed across roads to enable vehicular access. Maximum height of ramps is 250mm and bunds 0.5-1.15m. All grass and gravel areas (Figure 4-2) will be excavated and resurfaced with concrete to mitigate seepage into the local ground and soil. This also aids cleaning procedures following a spill. Any sludge that spills over the ramps will follow the road and end up in the site drainage and go back to the head of the works. The existing drainage network on site is pumped back to the head of the works, as per confirmation from TW Operations of Crawley and the drainage plans updated in 2020.

4.2 Mitigation of Site-Specific Risks

4.2.1 Jetting and Surge Flows

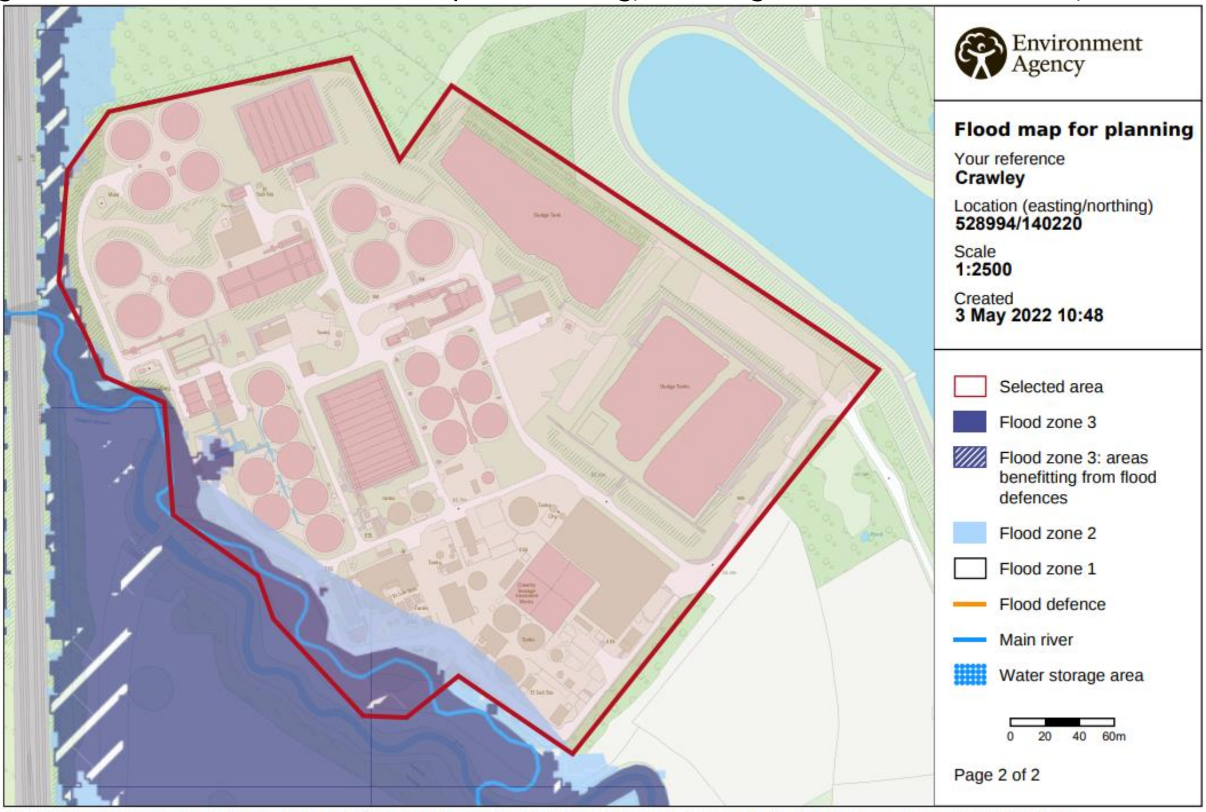
Due to the location of the tanks and their distance from the boundary of the containment area, there is negligible risk of contamination through jetting.

There is a low risk of jetting occurring as the majority of the digester tanks are concrete construction, for which catastrophic failure is deemed to be less of an issue. Failure is more likely to begin with major seeping from the tanks which would be spotted during routine site walkabout tours each day.

The natural topography of the site and the distance to the boundaries of the containment area results in a low risk of surge overwhelming the containment.

4.2.2 Flooding

According to the UK Government's Flood Map for Planning, the sludge area is in Flood Zone 1, as shown



in Figure 4-3. However, Flood Zones 2 and 3 can be seen bordering the western site boundaries. The flood would likely originate from the Gatwick Stream passing the site in the west and south. This site can therefore be deduced as Flood Zone 3 in its entirety. Crawley STW has a 1 in 100 or greater probability of river flooding. Mitigation measures are to be further for fluvial flooding given that the probability of flooding in the area is high.

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

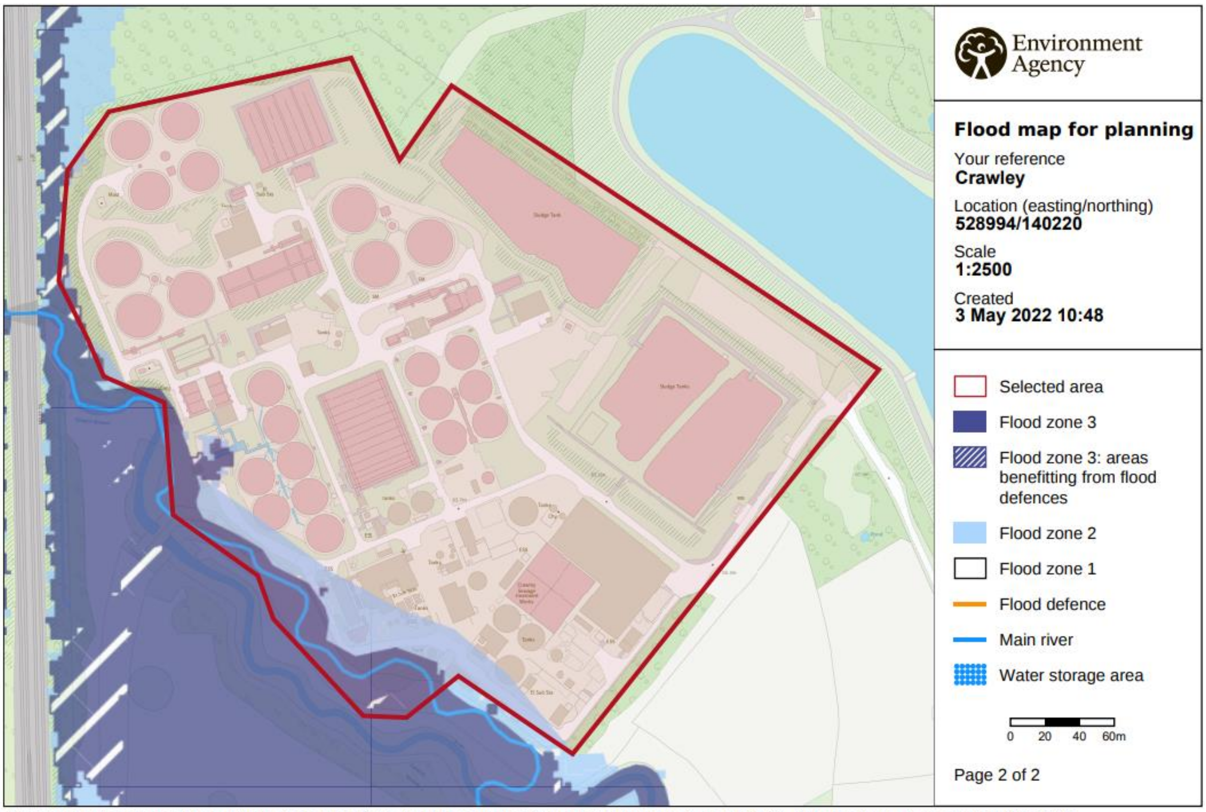


Figure 4-3 - Extent of Fluvial flooding in Crawley due to extreme weather events

4.3 Identification of Preferred Option

The preferred containment proposal is Option 1 which considers the following advantages:

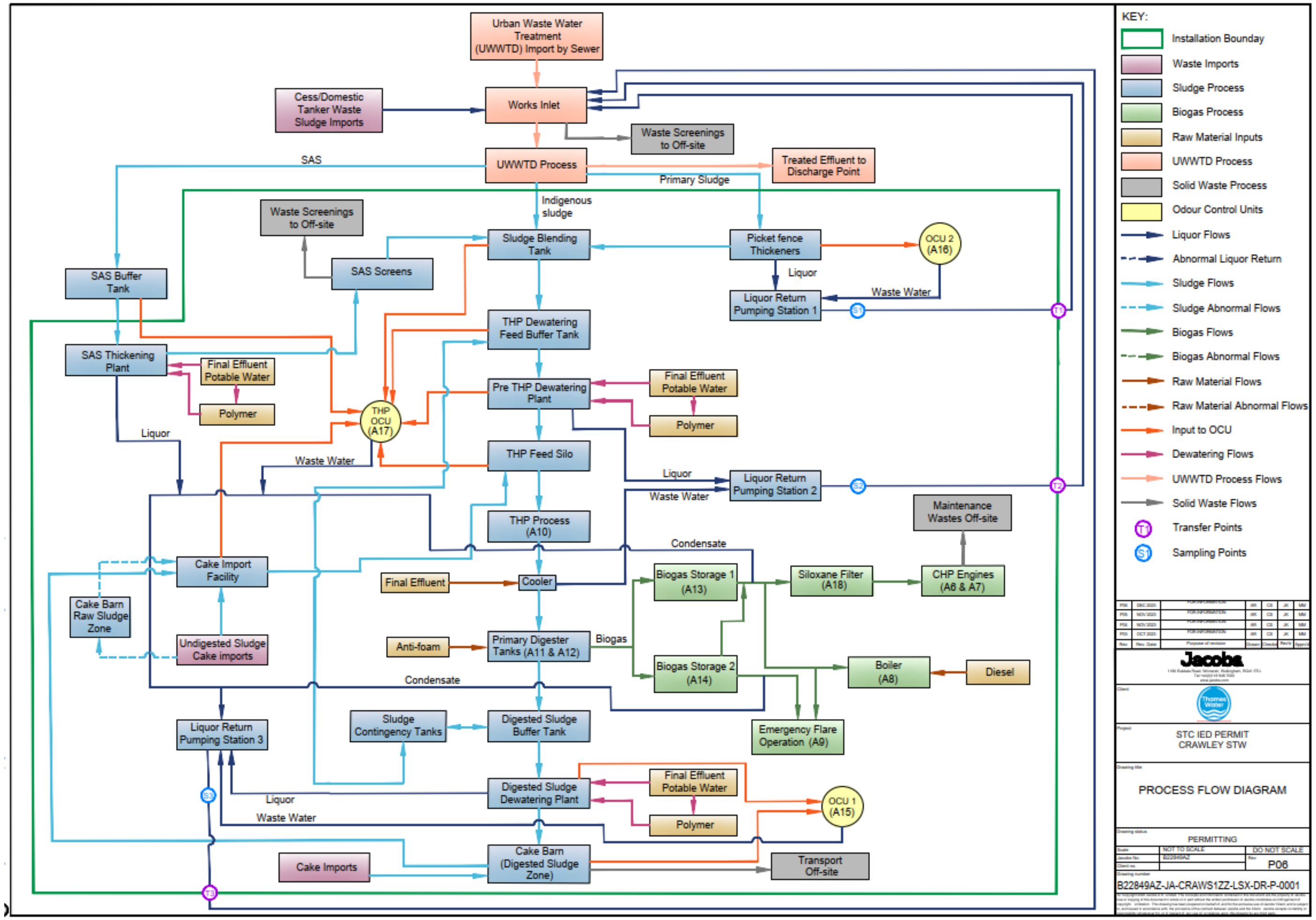
- Efficient use of assets/space (using disused digester as storage volume and any excess volume contained within the embankment shell that encloses the operational digesters).
- Practicality of installation (lower containment bund construction required).
- A lower bund wall will minimise long term site operational impacts including line of sight and ease of access.
- Access road operation simplified along higher traffic routes, by use of ramps to cross containment lines rather than by the use of floodgates.

4.3.1 H&S and CDM risks

- Flood gates not suitable for areas of high traffic movement.
- Cable ducts and fibre ducts act as conduit to transport sludge around site.
- Confirm that the containment walls do not impact the existing DSEAR equipment rating.

5. Site Drainage and liquor returns

5.1 Process flow diagram



5.2 Foul Process and Effluent Drainage

There are no existing site drainage plans. From a site visit with the Performance Manager on site, they confirmed that the site drains fully to the works inlet. Supplementary survey work has been undertaken to confirm the discharge at Crawley.

Containment options onsite involve replacing existing impervious areas with concrete. This will result in a small increase in site surface waters, which are likely to have a negligible additional effect on the head of the works given the scale of flow to full treatment at Crawley.

5.3 Liquor Returns

The existing liquor return system is not being altered by the containment system, other than the control modifications proposed in Section 5.4.

Details of the liquor returns sampling are being developed outside of this report for incorporation within the permit submission.

5.4 Automatic Isolation Valves

For the catastrophic loss of containment scenarios, 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 existing 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 Crawley being large, minor spill flows will not adversely impact the process.
- In most locations, to accommodate the new isolation valves, new sealed manholes need to be constructed over the existing drainage lines.

6. Conclusions

This section summarises the findings of the containment assessment options report for Crawley Sewage Treatment Works.

In the Risk Identification Report for Crawley a containment classification report was carried out. An overall site risk rating of Medium was determined meaning that class 2 containment is needed. The detailed requirements for class 2 containment have been outlined in the Risk Identification Report in Section 3.3. The assessment focuses on site-specific risks and outlines the options available for providing secondary containment of a catastrophic tank or digester failure.

The total contained volumes comprise:

Table 7 – Summary table of contained volumes for each area

Wide containment area		
25% Rule	**1603**	
110% Rule	**1816**	
Largest + rainfall	**3017**	Emerging critical case

The results of the uncontained spill mapping show that a catastrophic spill will not be contained with the boundary. The contained spill modelling retains the tank contents and associated rainfall within the site boundary and the flows can be managed by TW operations for return to treatment.

Existing gravelled and grass areas within the containment will be replaced with concrete. Elements of the site roads will be replaced/repaired to allow them to present an impermeable surface.

In addition to the containment elements, isolation of the site drainage system linked to the containment area will be required to mitigate the risk of unmanaged flows impacting the sewage treatment works.

Freeboard allowances and the profile of the containment bund wall provides mitigation against surge effects. Jetting escape is mitigated due to the location of the tanks being remote to the containment boundary.

Appendix 1 ADBA Site Hazard Risk assessment summary for Crawley 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 Crawley 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 such as ferric sulphate for sludge thickening.

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

Pathway – There are five pathways that have been identified:

1. The process and site drains take any liquid to the head of the works which would negatively impact the process stability on site and would eventually impact on the receiving watercourse.
2. There are several areas where a sludge spill could pass over permeable ground.
3. The STW lies uphill from adjacent industries and waterbodies.
4. West / Southwest of the site lays Gatwick stream, a watercourse travelling southward.
5. The site inventory has a runoff time of 3 minutes (nearest site boundary 36m away).

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

Receptor – There are six potential receptors which have been identified:

1. The site drainage system and the head of the works.
2. Groundwater vulnerability is ranked as “Medium-High” in Groundwater vulnerability Map by Defra, for half the plant, and “Medium-Low” for the other half.
3. The A23 road and railway to the west of Crawley STW.
4. Gatwick airport, the UK’s second busiest airport. Their extended car parking lays directly north.
5. Gatwick stream (watercourse) adjacent to Crawley STW to the west/southwest.
6. Horleyland Wood directly north of Crawley 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.

Appendix 2 Tank Covering initial review

There are five uncovered tanks within the permit boundary at Crawley STC; the four old secondary digesters acting as sludge storage tanks and the digested sludge buffer tank.

It is acknowledged that there may be emissions of biomethane and / or odour from some of these tanks, and Thames Water is preparing a monitoring exercise to determine the nature of any emissions and their quantity. Based on these outputs, the requirement for covering the tanks will be assessed on a prioritised basis, in accordance with the design of the existing tanks and HSE requirements around specialist equipment and DSEAR, in accordance with the applicability notes for BAT 14d.

As part of any tank cover design, the initial monitoring data will be necessary to determine if the correct routing of any gas from the tank headspace would be to the biogas utilisation system; to an OCU or another option. The quantification of tank emissions is needed to determine if the gas treatment assets also require upgrading, e.g. existing engine utilisation levels and gas storage system.

Due to the variability of air pressure underlying the potential release rate of gas from the tank contents, it is proposed that the monitoring exercise will consider a minimum number of sampling rounds during a 12-month period, to reflect emission levels at different ambient air temperatures and atmospheric pressures. Where multiple tanks for the same purpose are on a site (e.g. secondary digesters) it is proposed to monitor a representative tank rather than all of the same type.

Monitoring will be undertaken using appropriate methodology for the nature of the tank. Being open topped, monitoring falls outside of standard Environment Agency guidance such as M1 and M2. However, it is proposed to use an area sampling technique, similar to that proposed in the M9 document for bioaerosols, through use of a 1m square sampling hood, with an integral chimney which can be used for extractive sampling. This sampling will be undertaken by appropriately qualified contractors, preferably MCERTS certified.

As an illustration of the proposed technique, a minimum of two air samples will be taken from each sampling location, one for odour assessment and one for VOC measurement, at an appropriately MCERTS or UKAS accredited laboratory, as well as gas flow being measured when the sampling hood is in-situ. The measured concentrations will be assessed against UK government clean air values to determine the impact, if any, on air quality from the tank contents. These results will then feed into the design of any identified cover system to ensure that any emissions are appropriately handled.

Any proposed coverings will be subject to a cost benefit analysis, based upon the Environment Agency tool.