J840 – STC IED Containment

Swindon STC – Containment Options Report

March 2024

Thames Water

Project No: J840
Document Title: Swindon STC – Containment Options Report

Document No.:
Revision: P02
Date: 18/03/2024
Client Name: Thames Water
Project Manager: Harindra Gunasinghe
Author: Kevin Grant
File Name: B22849AZ Swindon STC – Containment Options Report

Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
P01	16/12/22	First Issue	KG	SMNS	SC	HG
P02	05/12/22	Update to IED/PFD	KG	SMNS	SC	HG
P03	18/03/2024	Update to IED/PFD	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 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 Swindon.

Swindon serves a population equivalent of 209,000 taking in sewage from Swindon and surrounding area. 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.

Swindon holds some 11,714m^3 of sludge in 10 tanks requiring containment with individual volumes varying between 100 and 1686m^3. All the tanks requiring containment are of steel construction.

The eastern and southern boundaries of the STW are on higher grounds and in the event of a sludge tank failure, would act as bunds, preventing sludge from leaving the site. However, there are gaps in the northwest, west and southwest of the site boundary. Any spilled sludge reaching the gaps would have a higher risk of spill into the adjacent woodlands, fields and inevitably to River Ray.

The containment volume of 2929m^3 is driven by the 25% rule (25% of total tank volumes) rather than 110% (of the largest single tank) of the total tanks volume or the largest tank plus an allowance for rainfall.

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.

Two wide area options for containment have been identified:

1. Option 1 utilises containment surrounding the total containment permit area, in additional to a storage lagoon to provide secondary containment to the sludge processing facilities. Where the containment boundary crosses access roads, ramps (speed bumps) have been used to maintain access on the most frequently trafficked routes. Where access is not required as frequently, and the spill height is greater than 300mm flood gates are proposed.

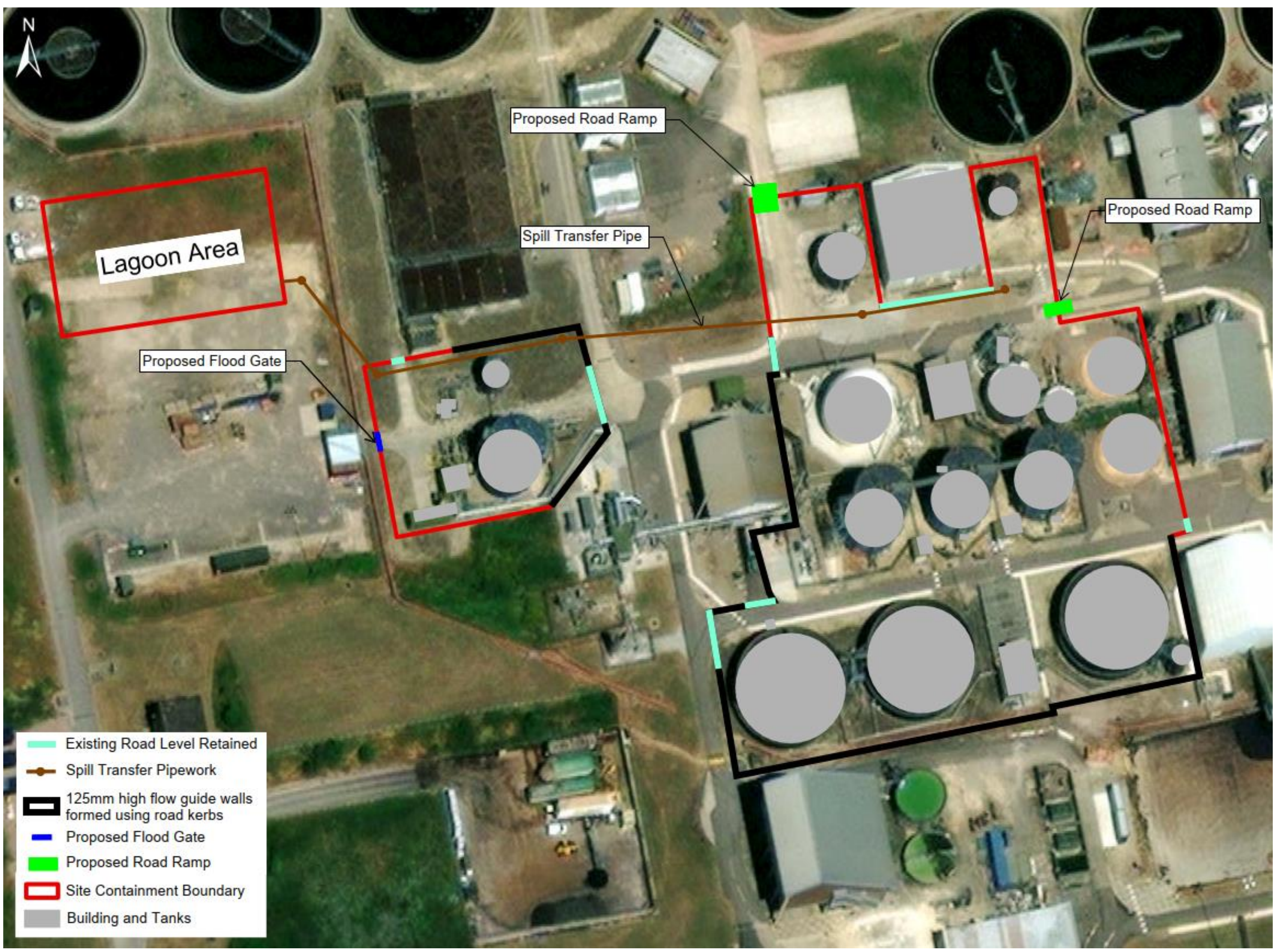
2. Option 2 aims to remove the need for a storage lagoon by taking advantage of the topography of the site to maximise the storage in the proposed containment area. This is achieved by incorporating terraces at key locations within the containment area to hold any spill until a specific level is achieved before spilling to the adjacent containment subarea.

It is recommended that Option 1 is progress as it meets the TW Operations constraints relating to maintaining access around the site for normal operation whilst incorporating long-term containment.

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 a 3-day recovery period. Vehicular access into the containment areas where frequent access is required is by ramps (speed humps) restricted to nom 300mm in height; where traffic movements are expected to be less frequent and the threshold for ramps is exceeded, permanent flood gates were proposed. 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.

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 conveyance to the site drainage system which eventually discharges to the head of the works.

General Layout of Preferred Option



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 Swindon 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 Sewage Treatment Works (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 Swindon STW were identified through a desktop study, Light Detection and Ranging Analysis (LiDAR) analysis and a site visit.

Swindon STW (Figure 1) is located in the Thames Valley, South region of Thames. The site lies east of the River Ray and is surrounded by commercial and industrial businesses to the south, east and northeast. There is a field to the north, a residential area to the southeast and a public road (Barnfield Road) to the south of the site. The STW serves a population equivalent of 209,000.

Figure 2 shows the Boundary of the permitted IED area and the assets contained within Swindon STW.

Figure 1: Satellite view of Swindon Sewage Treatment Works

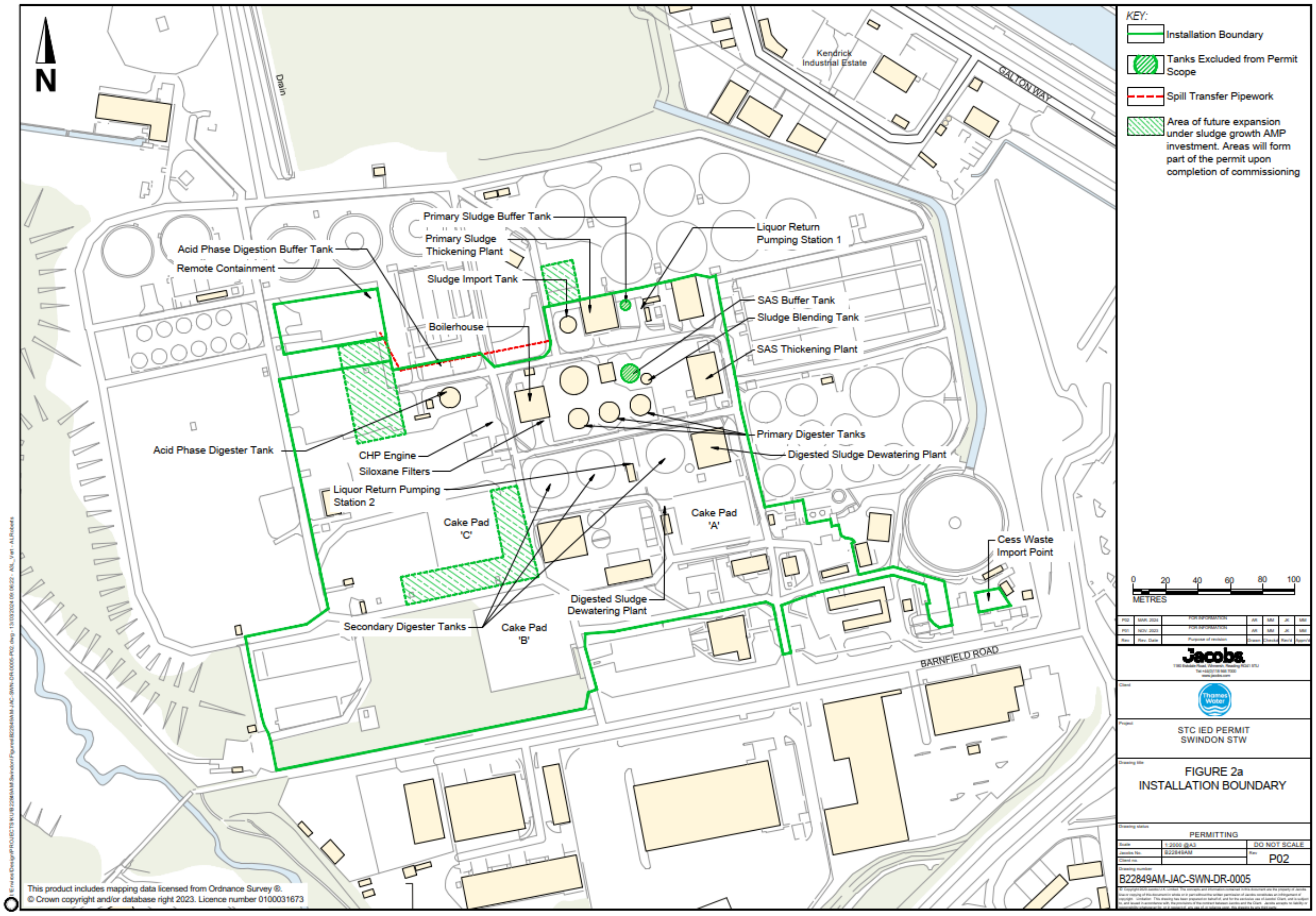


Figure 2: Boundary of Permitted IED area and assets contained within Swindon STW

3. Proposed Containment at Swindon 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;

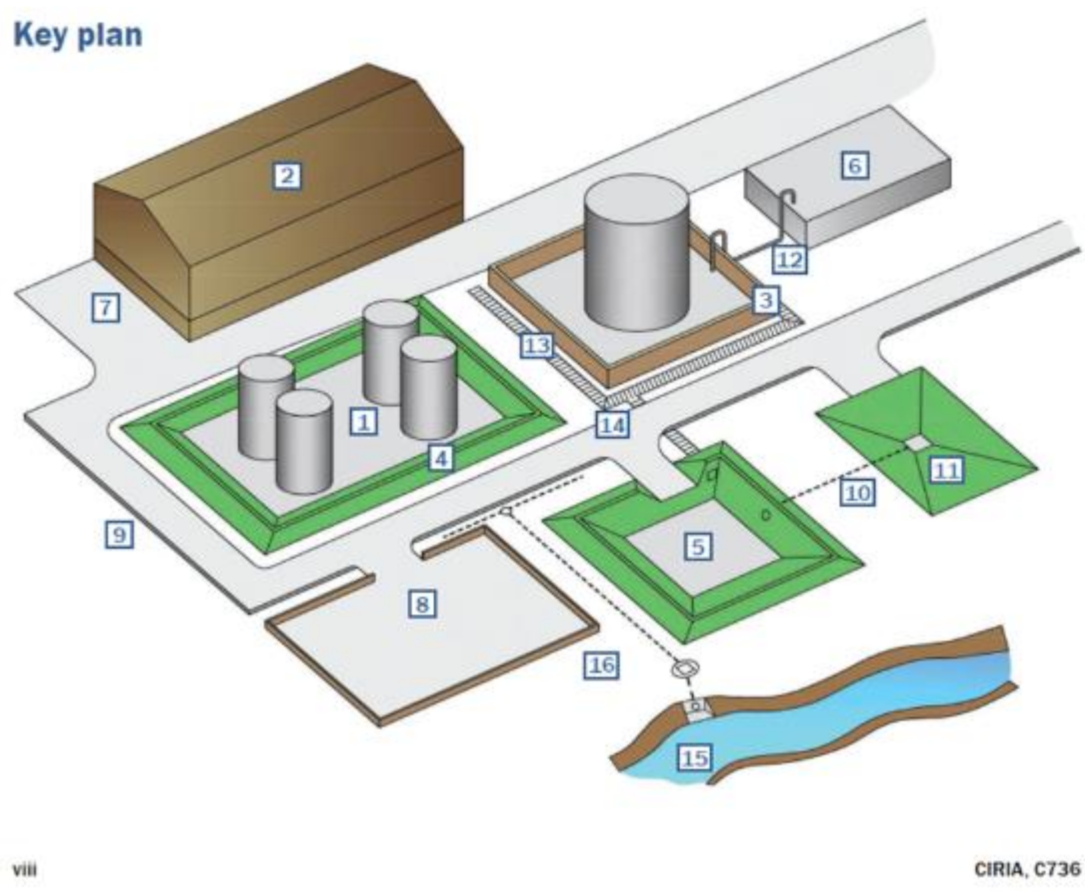


Figure 3: Diagram of primary, secondary and tertiary containment examples

-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. A development opportunity may allow select pumping stations discharging back to head of the works to be inhibited.

3.2.1 Uncontained Spill modelling

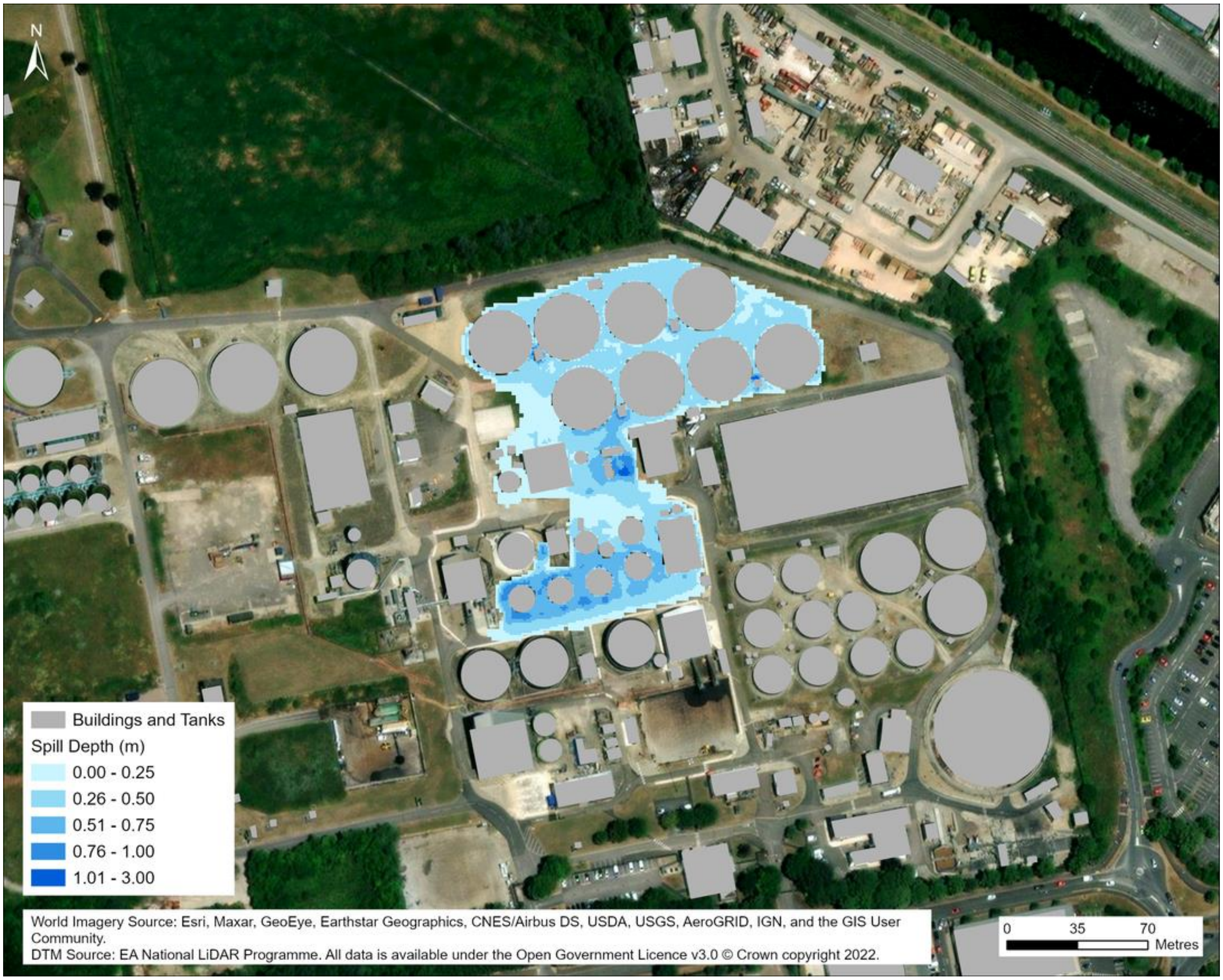


Figure 4: Uncontained Spill Model Results

As seen from Figure 4, the sludge spill mapping of an uncontained event at Swindon STW showed that a potential sludge spill from the one of the Primary Digesters will be contained within the site and therefore passive containment only needs to be implemented to safeguard the site operation and to prevent contamination of the receiving watercourse. According to the model, the spill will reach the fullest extent of spread in approximately 15 minutes after the failure of one of the digesters.

Assuming the spilled sludge originates from the failure of one of the Primary Digesters on site, initially the spill will fill the Primary Digesters area. The ground level to the west and south of the digesters will act as bunds thus preventing the sludge from flowing further in these directions. Part of the sludge will flow eastwards towards the SAS Dewatering building after which it branches northwards.

Most sludge from the failed tank will flow northwards. Some of this sludge will flow midway into the pathway between the Biogas holder and the building to the east of it, after which further flow will be stopped by the high ground (berm) in this area. The rest of the sludge will travel northwards towards the tanks on the northeast corner of the STW through the internal pathways surrounding the SAS Dewatering Building, Sludge Blending Tank, SAS Storage tank, Imported Sludge Tank, Raw Sludge Building, Raw Sludge Buffer Tank and the 3MW Diesel Generator. From here, the sludge will further spread eastwards to the tanks in this region. The berms on the northeast boundary will prevent the sludge from flowing outside the northeast site boundary.

3.3 Site Classification Swindon STW

Based on the use of the ADBA risk assessment, considering the source, pathway and receptor risk Swindon 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 summary of the ADBA risk assessment tool.

3.4 Swindon STW Summary of Assets and Secondary Containment Requirements

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 of the guidance 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 of the CIRIA guidance that sewage sludges and associated regulations / guidance are not listed.

Within Section 4.2.1 there is detailed reference to the use of 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. Sections 4.3 and 4.4 of CIRIA 736 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.

3.4.1 Assets for Containment

The tanks for which containment is required are summarised below:

Table 3-1: List of Tanks Requiring Containment

Tanks Requiring Containment	Number of Tanks	Individual Effective Tank Volume m^3	Total Effective Tanks Volume m^3	Material	Below/ Above/ Partially in ground
Sludge Import Tank	1	315	315	Steel	above
Sludge Blending Tank	1	500	500	Steel	above
Acid Phase Digester Tank	1	1,075	1,075	Steel	above
Acid Phase Digestion Buffer Tank	1	100	100	Steel	above
Primary Digester Tanks	3	1,672	5,016	Steel	above
Secondary Digester Tanks	3	1,686	5,058	Steel	above
Total	**10**		**12,064**		

3.4.2 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 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 Swindon is 76 mm. It should be noted that the rainfall depths for Swindon 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.

3.5 Identified Constraints

3.5.1 Operational constraints

Below are the key Operational constraints that have been identified during the development of the proposed containment area at Swindon STW.

- Ground surface of the containment area will need to be easy to clear of sludge. The existing ground surface is a mix of concrete, grass and gravel. TW operations have stated that it would be difficult to clean up sludge from gravel areas as the gravel would also sucked up with the sludge. The grass and gravel areas will need to be replaced with impermeable surface e.g. concrete from which sludge can be cleared up easily.
- 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.
- Access is to be maintained where the proposed containment boundary crosses access roads. This could be achieved using road ramps (speed bumps), flood gates etc.
- Where access into buildings and operation areas are impacted by the containment boundary, access is to be maintained or an alternative access arrangement is to be provided (e.g. steps, flood gate, alternative route etc.)
- In some areas there are significant amount of above ground pipework and cabling which may need to be temporary diverted if it is not possible to excavate and install the concrete containment in these areas.

3.5.2 Geotechnical and Environmental constraints

Existing ground conditions are unknown however this will 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 Topographical Constraints

The digital terrain model (Figure 5) indicates the eastern and southern boundaries of the STW are on higher grounds and in the event of a sludge tank failure, would act as bunds, preventing sludge from leaving the site. There are gaps however in the northwest, west and southwest of the site boundary.

All tanks requiring containment except for the Acid Phase Tank and the Acid Phase Buffer tank, are located to the east of high ground running north to south through the centre of the site. Any spills in this area will be contained on the site as demonstrated by the uncontained spill model results shown in Figure 4. Any spilled sludge from the Acid Phase Digester Tank or the Acid Phase Buffer Tank reaching the gaps in north-western and western areas of the site boundary would have a higher risk of spill into the adjacent woodlands, fields and River Ray would be inevitable.

Figure 5: Digital Terrain Model of Swindon STW

3.5.4 Other constraints

None identified.

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 Swindon, 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 Swindon 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. 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 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.
- Local infill of grass/gravel to create an impermeable surface and facilitate containment and conveyance.
- Raised kerbs on high ground to guide 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

4.1.1 Containment Option 1 – wide area containment supplemented with a storage lagoon

This option utilises containment surrounding the total containment permit area, in additional to a storage lagoon to provide secondary containment to the sludge processing facilities. The containment area is approximately 13,050m^2 but the actual available containment area will be less than this as areas such as the tanks and the sludge and dewatering buildings will not be included in the storage volume.

4.1.1.1 Total Spill Volumes

The containment volume has been checked against the 110 and 25% rule and the 25% rule applies.

The total design contained volume comprises 2929m^3 (25% of the total volume of all tanks within the containment area), compared to largest single tank failure of 1,686m^3 and total rainfall 987m^3 rainfall from Flood estimating handbook over catchment area, which giving a lesser volume 2673m^3. Table 4-1 summarises the check of the total design containment volume against the 110 and 25% rules as well as the largest tank plus rainfall.

Table 4-1: Option 1 Design Spill Volume Summary

Design Spill Volume Summary		
Rainfall (mm)	76	
Catchment Area (m^2)	13050	
Total Rainfall (m^3)	987	
Tanks within Containment Area	**No. of Tanks**	**Volume (m^3)**
Sludge Import Tank	1	315
Sludge Blending Tank	1	500
Acid Phase Digester Tank	1	1,075
Acid Phase Digestion Buffer Tank	1	100
Primary Digester Tanks	3	1,672
Secondary Digester Tanks	3	1,686
Total Effective Volume (m3)	**10**	**11,714**
Largest Tank plus Rainfall (m^3)	2673	
110% of Largest Tank within Containment Area (m^3)	1855	
25% of All Tanks within Containment Area (m^3)	2929	
Design Spill Volume	**2929**	

4.1.1.2 Contained Model

The contained model output for Option 1 is shown in Figure 6 and Figure 7. This identifies the total design spill volume will be contained at a fairly uniform depth around the high ground within the containment area located adjacent to the boiler house and the secondary digesters. The containment model shows that when total design spill volume of 2929m^3 is contained in this area, the top water level will settle at 90.89mAOD. Therefore, allowing for 250mm freeboard on the bund wall the bund height will vary between 0.25 – 1.08m with the higher bund wall along the northern and north-eastern sides of the containment area.

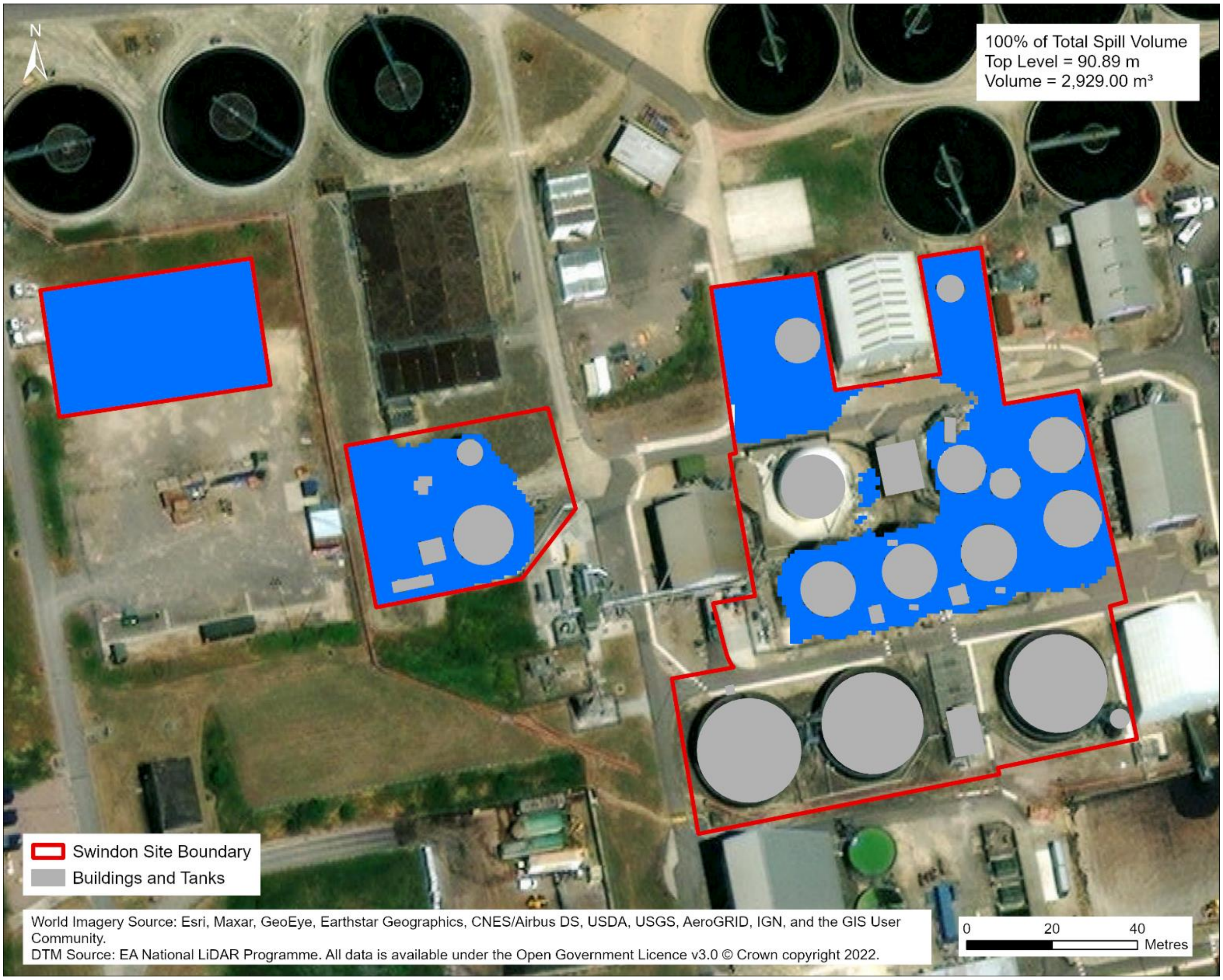


Figure 6: Option 1 Containment Spill Model Output

Figure 7: Option 1 Containment Spill Model Output at 25%, 50%, 75% and 100% Volumes.

Figure 8 shows the spot levels along the containment boundary where the spill reaches the edge of the containment boundary. Some of the potential depths at the western edge of the containment area near the Acid Phase Tank are in excess of what ramps can hold therefore this location will require the use of floodgates instead of ramps.

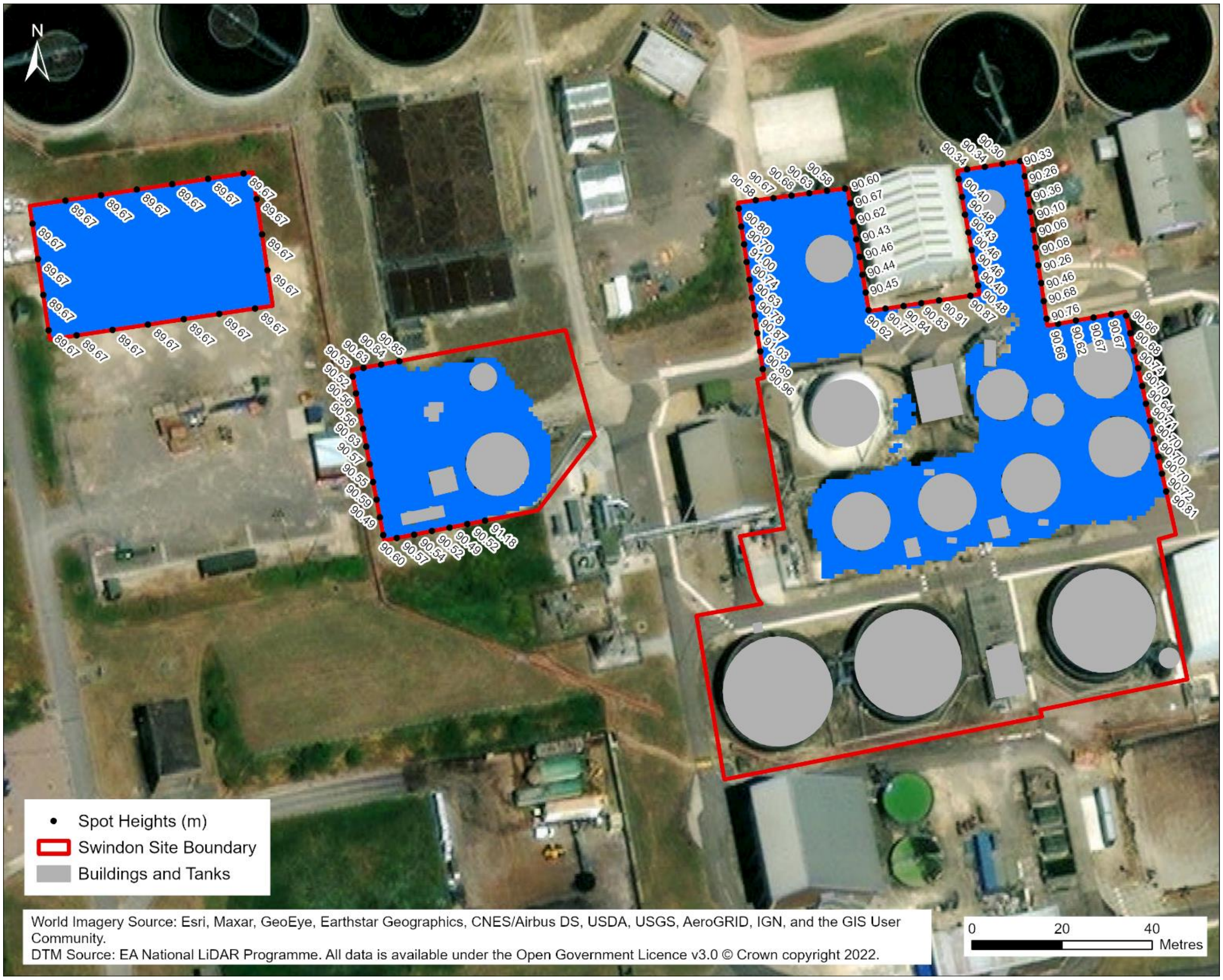


Figure 8: Spot Levels along Containment Boundary

Summary of the recommended containment for sludge area is described below and shown in Figure 9.

- Approximately 350m of low concrete bund wall ranging between 0.25m and 1.08m high with an average height of 540m. The foundation for the bund wall will extend 300mm below ground level.
- Approximately 340m of precast concrete kerbing to guide flows around the containment 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.

- 2no. 250mm high road ramps across existing access to maintain access. There are a further 6 access points (roads and buildings) that are crossed by the containment perimeter which are a sufficiently high level to provide the required containment.

- To minimise the bund heights and facilitate the use of road ramps to maintain vehicular access a 30m x 50m, 1.2m deep lagoon is required with reinforced concrete walls extending to the greater of the required flood level in this area or 1.5m above final ground level.

- Pipework and associated access chambers will be required to transfer spill flows to the Lagoon.

- There is the potential for some flow to overtop the access ramps during the conditions of the initial burst which is addressed by conveyance to the site drainage system which eventually discharges to the head of the works.

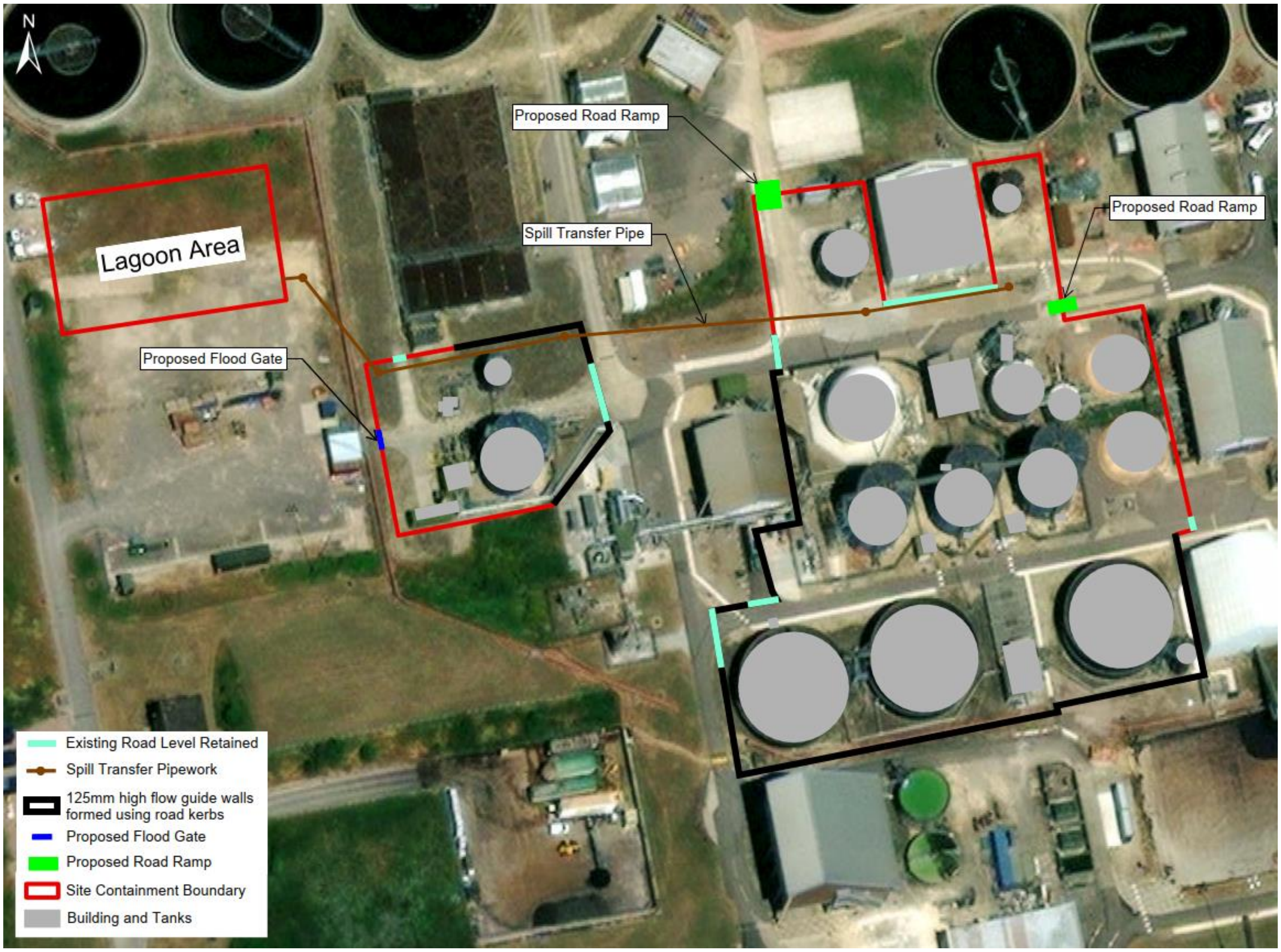


Figure 9 - Containment Option 1 - Wide area containment option

4.1.2 Containment Option 2– wide area containment without lagoon

This option aims to remove the need for a spill storage lagoon by taking advantage of the topography of the site to maximise the storage in the proposed containment area. This is achieved by incorporating terraces at key locations within the containment area to hold any spill until a specific level is achieved before spilling to the adjacent containment subarea. The containment area is approximately 11550m^2,but the actual available containment area will be less than this as areas such as the tanks and the sludge and dewatering buildings will not be included in the storage volume.

4.1.2.1 Total Spill Volumes

As for Option 1, the containment volume has been checked against the 110 and 25% rule and the 25% rule applies.

The total design contained volume comprises 2929m^3 (25% of the total volume of all tanks within the containment area), compared to largest single tank failure of 1,686m^3 and total rainfall 874m^3 rainfall from Flood estimating handbook over catchment area, which giving a lesser volume 2560m^3. Table 4-2 summarises the check of the total design containment volume against the 110 and 25% rules as well as the largest tank plus rainfall.

Table 4-2: Option 2 Design Spill Volume Summary

Design Spill Volume Summary		
Rainfall (mm)	76	
Catchment Area (m^2)	11550	
Total Rainfall (m^3)	874	
Tanks within Containment Area	**No. of Tanks**	**Volume (m^3)**
Sludge Import Tank	1	315
Sludge Blending Tank	1	500
Acid Phase Digester Tank	1	1,075
Acid Phase Digestion Buffer Tank	1	100
Primary Digester Tanks	3	1,672
Secondary Digester Tanks	3	1,686
Total Effective Volume (m3)	**10**	**11,714**
Largest Tank plus Rainfall (m^3)	2560	
110% of Largest Tank within Containment Area (m^3)	1855	
25% of All Tanks within Containment Area (m^3)	2929	
Design Spill Volume	**2929**	

4.1.2.2 Contained Model

The contained model output for Option 2 is shown in Figure 10 and Figure 11. This shows that the total design spill volume will be contained at differing levels across the containment area. In the southern edge of the containment area the level is the highest at 91.85mAOD. As the containment area extends to the north the level reduces to 91.30mAOD in the central area and 90.83mAOD in northern most area. These levels are achieved by setting a low bund wall between each area to hold the spill back until the spill level is achieved. Compares to Option 1 this allows more volume to be stored in the sludge area and removes the need for a lagoon. However, this option does result in greater water depths being contained requiring higher road ramps up to 300mm and in some cases where the contained depth across access roads is greater than 300mm, floodgates are proposed. Allowing for 250mm freeboard on the bund wall the bund height will vary between 0.10 – 1.06m with the higher bund wall along the western edge of containment area 2 and the eastern edge of containment area 1b.

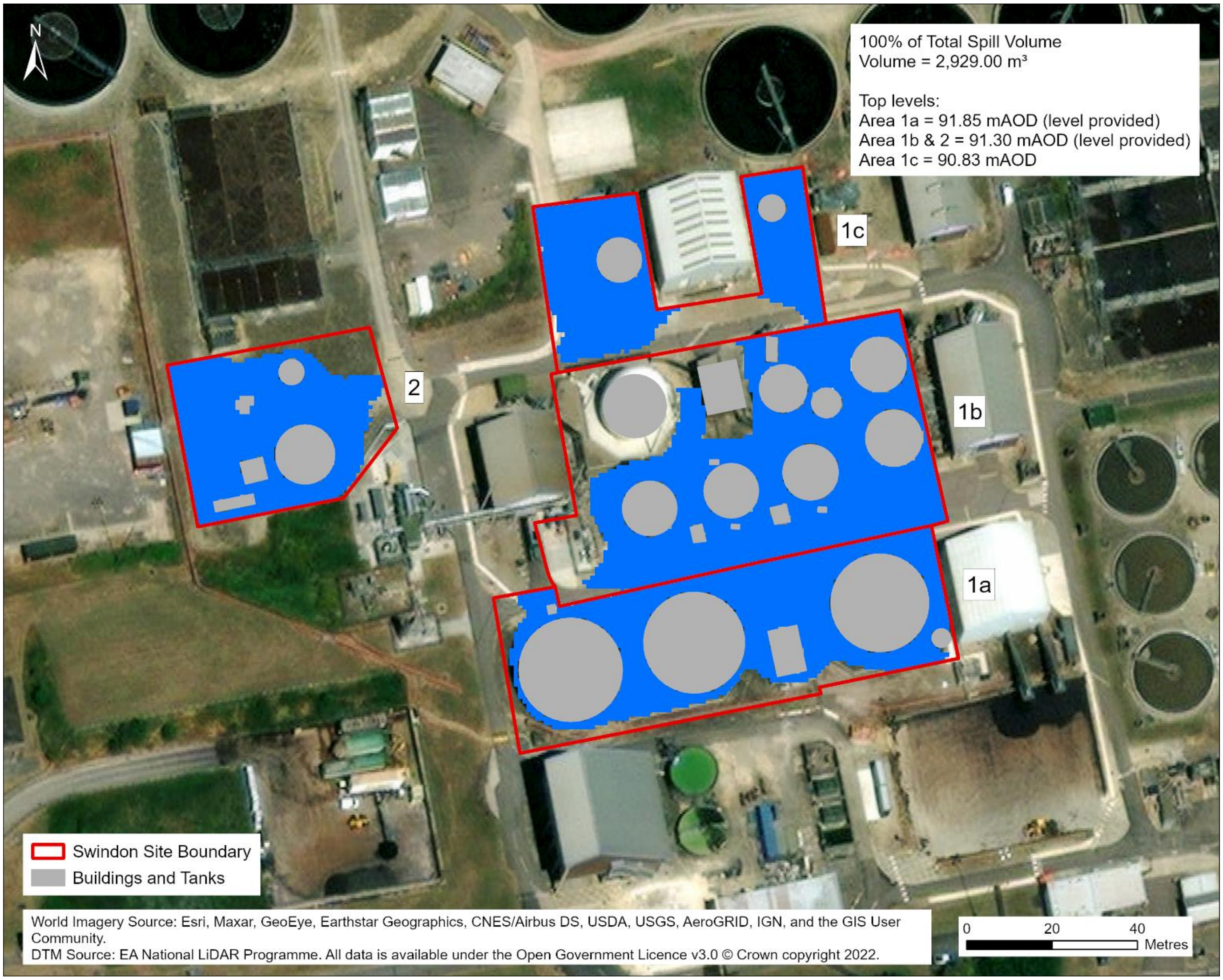


Figure 10: Option 2 Containment Spill Model Output

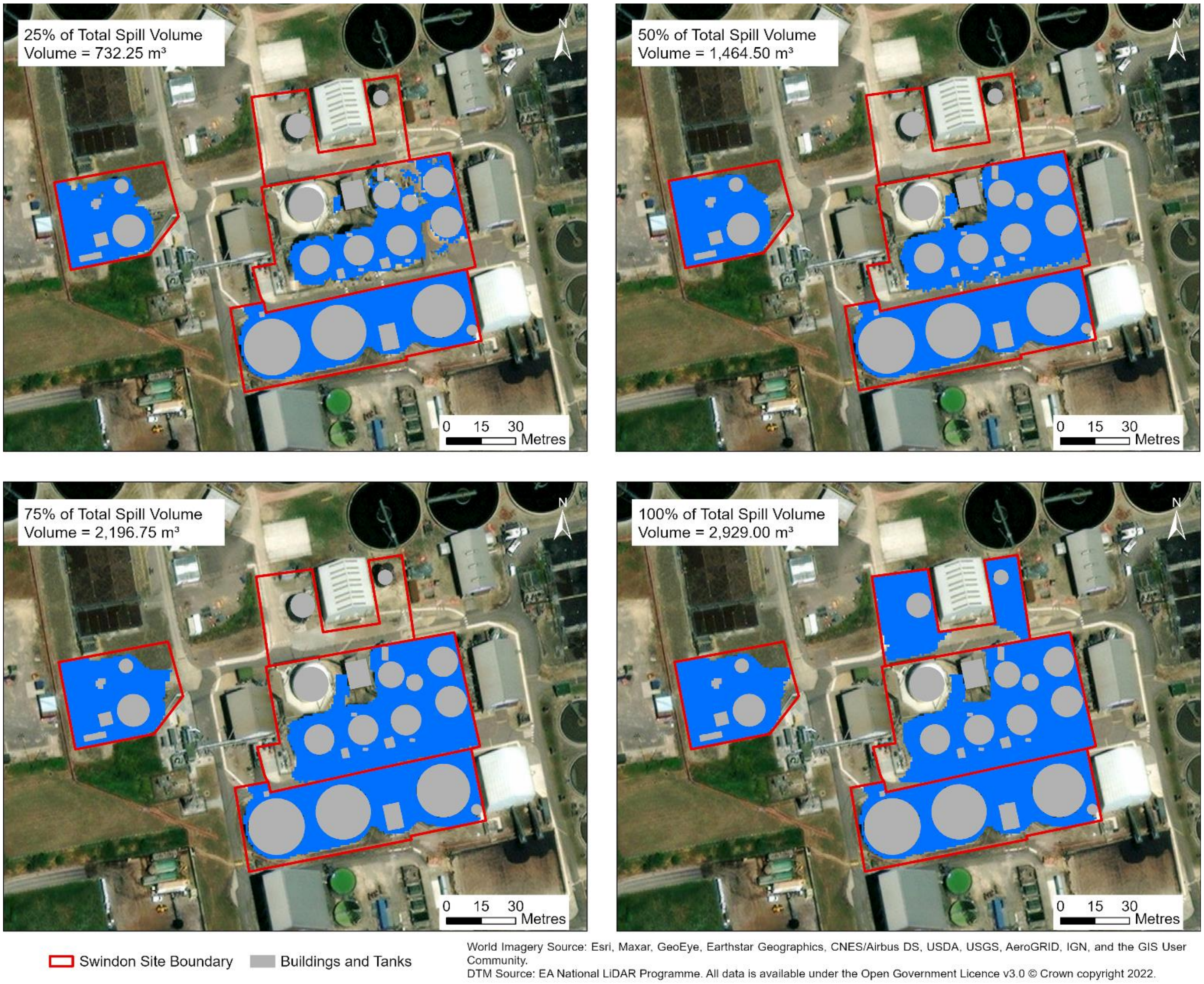


Figure 11: Option 2 Containment Spill Model Output at 25%, 50%, 75% and 100% Volumes.

Figure 12 shows the spot levels along the containment boundary where the spill reaches the edge of the containment boundary. Some of the potential depths at the western edge of the containment area near the Acid Phase Tank are in excess of what ramps can hold therefore this location will require the use of floodgates instead of ramps.

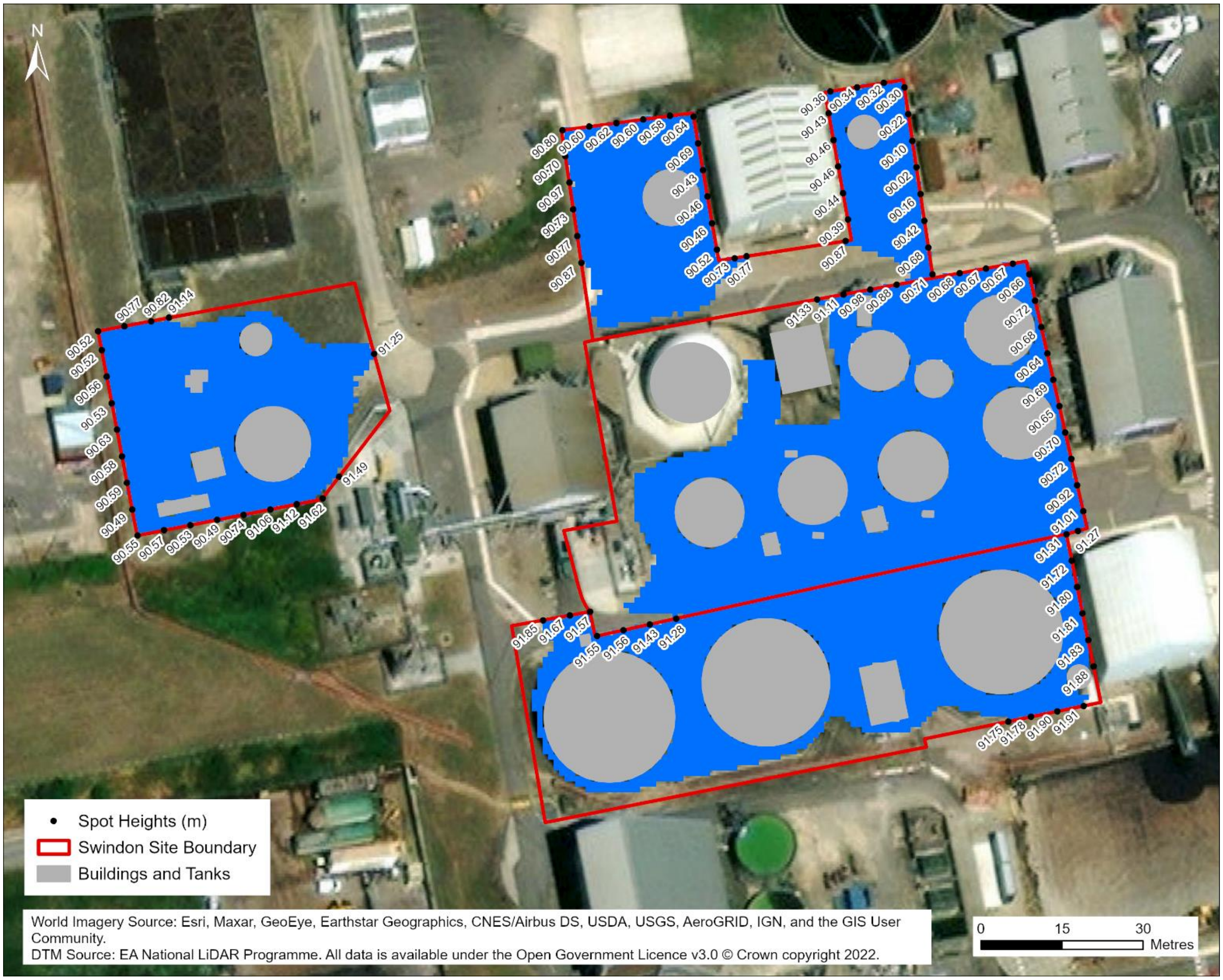


Figure 12: Option 2 Spot Levels along Containment Boundary

Summary of the recommended containment for sludge area is described below and shown in Figure 13.

- Approximately 645m of low concrete bund wall ranging between 0.25m and 1.06m high with an average height of 620m. The foundation for the bund wall will extend 300mm below ground level.
- Approximately 200m of precast concrete kerbing to guide flows around the containment 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.

- 5no. road ramps across existing access to maintain access. There are a further 4 access points (roads and buildings) that are crossed by the containment perimeter which are a sufficiently high level to provide the required containment.

- Areas 1b and 2 will be linked hydraulically using pipework and associated access chambers to transfer flows between the two areas.

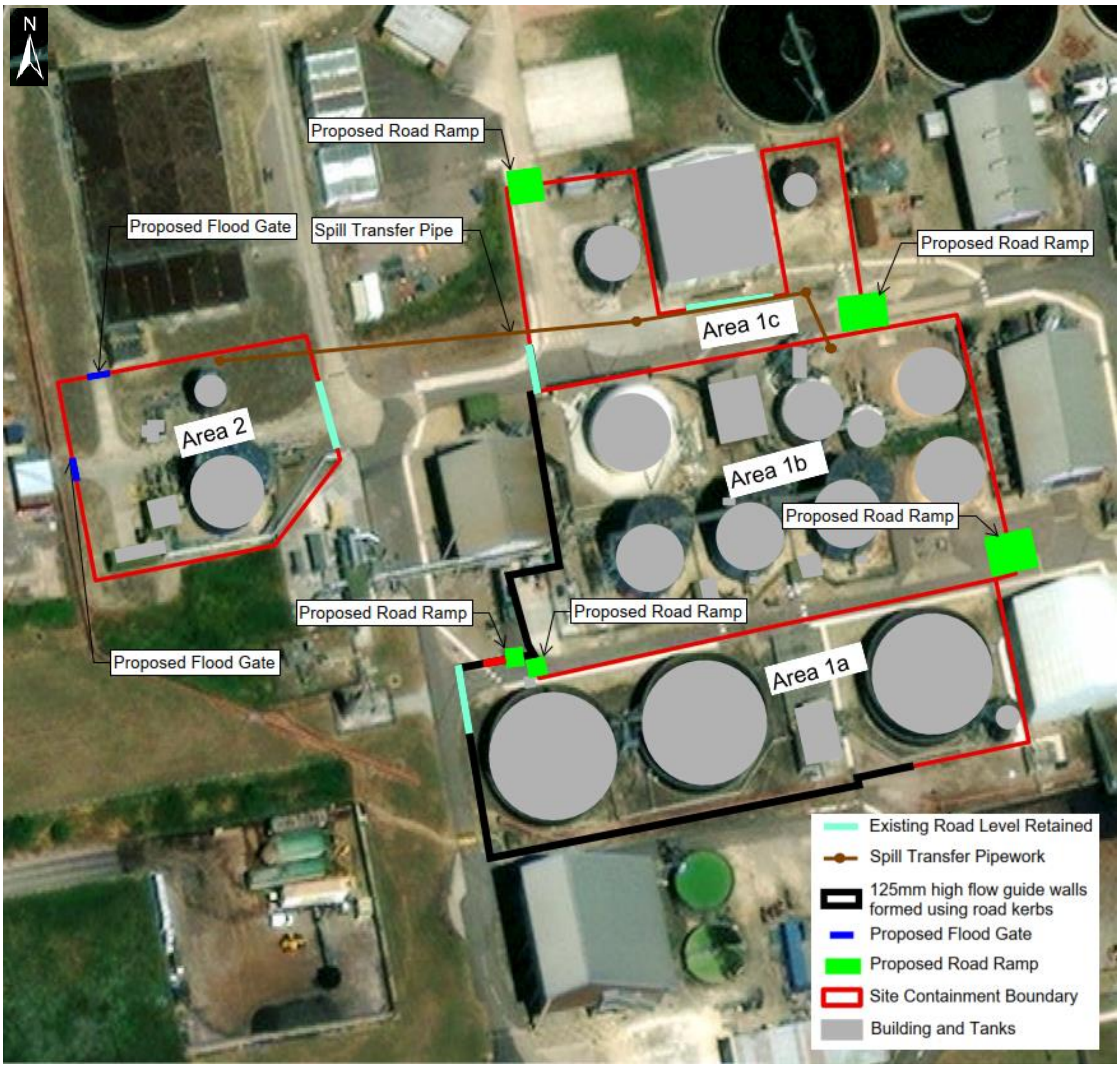


Figure 13 - Containment Option 2 – Terraced Containment Area Option

There is the potential for some flow to overtop the access ramps during the conditions of the initial burst which is addressed by conveyance to the site drainage system which will be pumped to the head of the works.

4.1.3 Tertiary Containment Option

No tertiary containment is provided at Swindon STW.

4.2 Mitigation of Site-Specific Risks

4.2.1 Jetting and Surge Flows

The potential for failure through jetting is minimised by ensuring that the minimum distance from the tank to the bund wall is in accordance with Box 6.1 of CIRIA 736.

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.

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 areas of the site is largely situated in Flood Zone 1, however there are three IED tanks that are located in Flood Zone 2, see Figure 14 below.

Areas situated in flood zone 1 have a low probability of flooding and have an annual probability of river flooding of less than 0.1% while areas situated in flood zone 2 have a medium probability of flooding and have an annual probability of river flooding between 1.0% and 0.1%.

The walls of any containment within the flood zone 2 area will need to be set above the flood level.

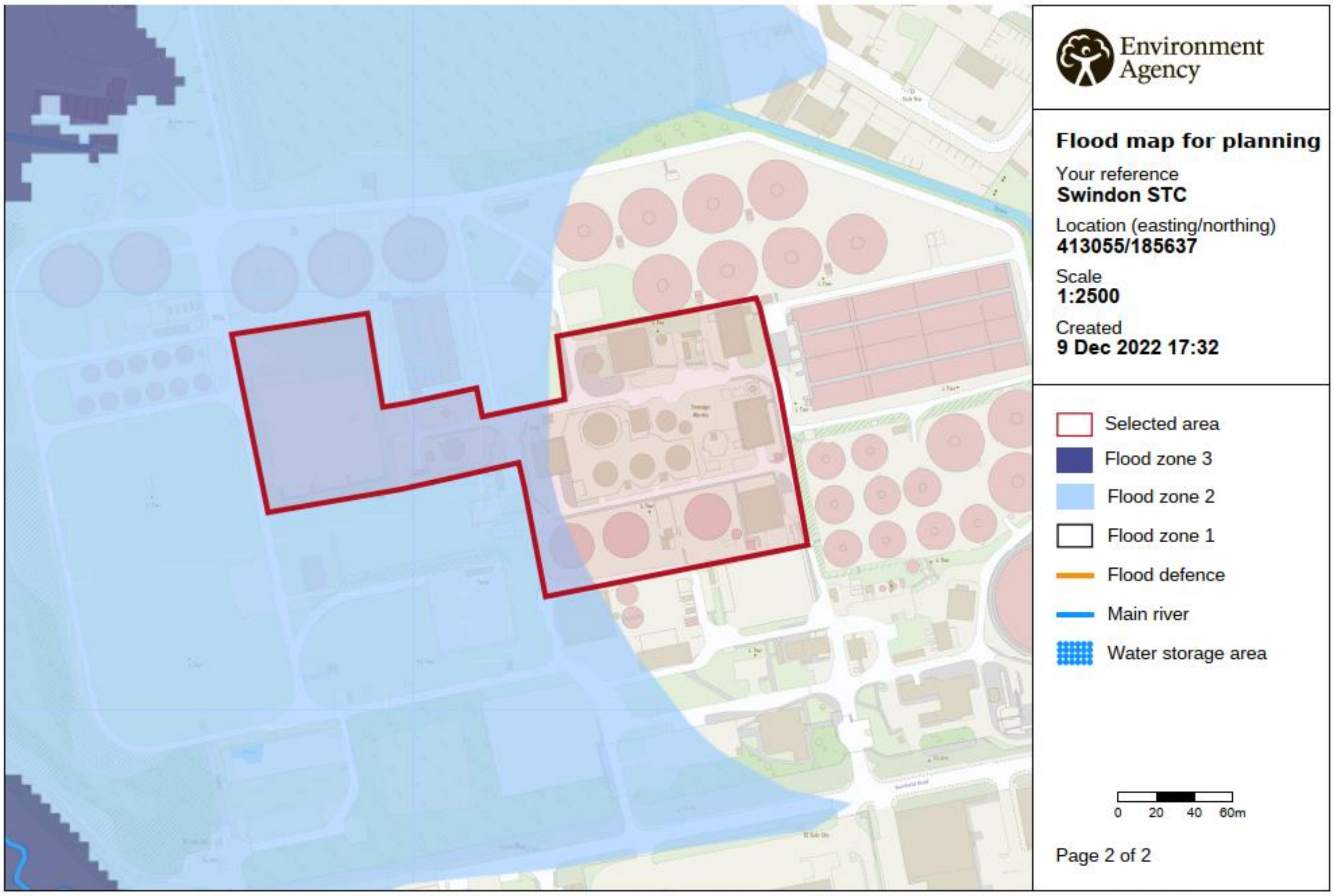


Figure 14: Flood Map for Planning

4.3 Identification of Preferred Option

The preferred containment option is Option 1 which utilises containment surrounding the total containment permit area, in additional to a storage lagoon to provide secondary containment to the sludge processing facilities. This option will require the construction of 350m of low bund walls (250 - 1080mm high) around the wide containment area, two ramps at road crossings and one floodgate where the spill depth is greater than 300mm at access road. A storage lagoon 30m x 50m is required to limit the depth in the containment area.

4.3.1 H&S and CDM risks

- Flood gates not suitable for areas of high traffic movement
- Sealing of cable ducts and fibre ducts to mitigate issue of acting 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

A copy of the process flow diagram is shown below as Figure 15.

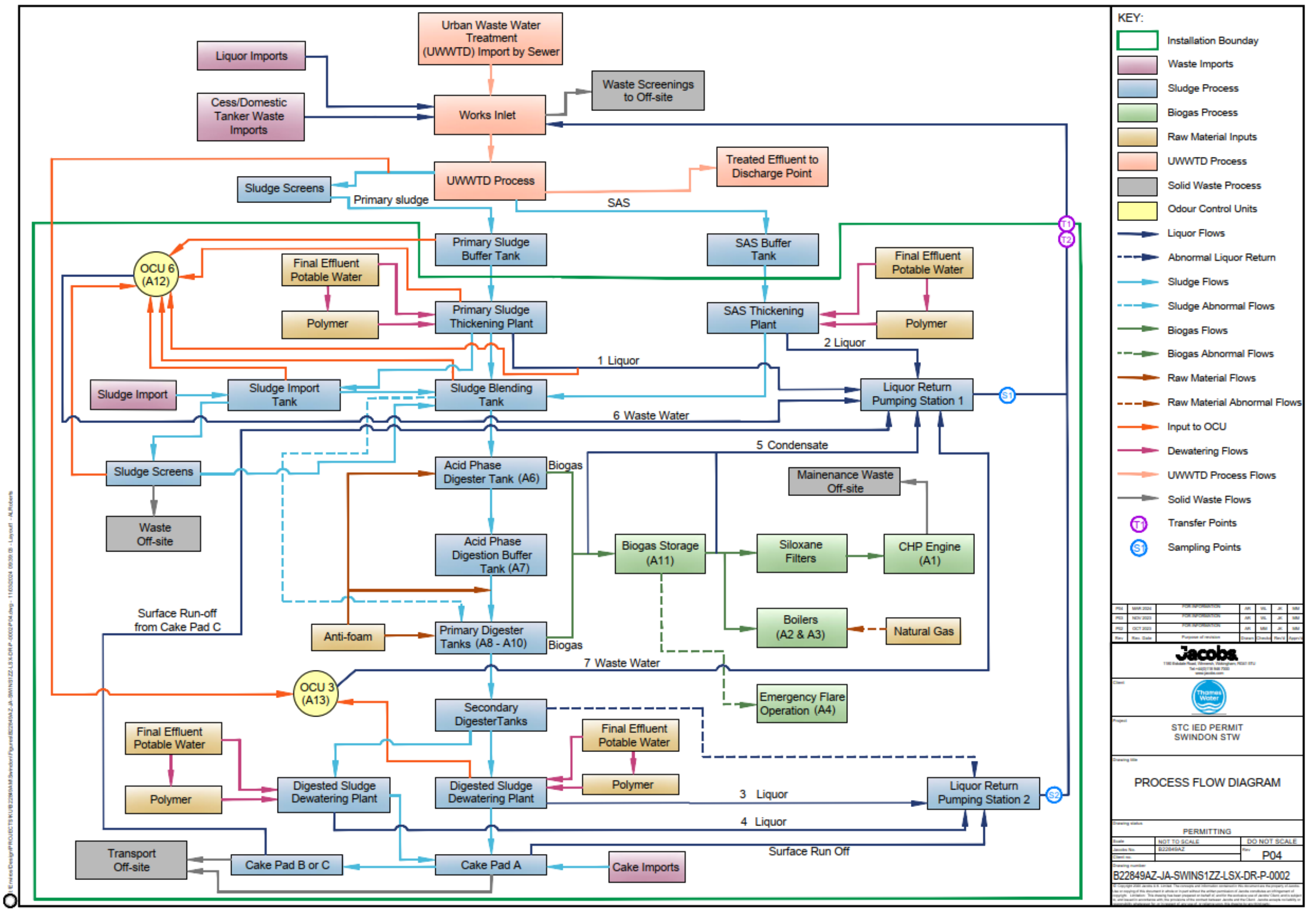


Figure 15: Process Flow Diagram

5.2 Foul, Process and Effluent Drainage

Site drainage assessments are based on Swindon STW Drainage Plan Drawing Number SWIN1ZZ-DPL-001. This drawing is dated March 2010 and it is likely that there have been modifications\ upgrade during this time. Therefore, a drainage survey is required, and the drainage plans updated to suit.

The Drainage Plan for Swindon shows that there are only Combined water sewers within the sludge area, indicated by green lines, which discharge to pumping stations eventually sending flows back to the head of the works shown in Figure 16. 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.

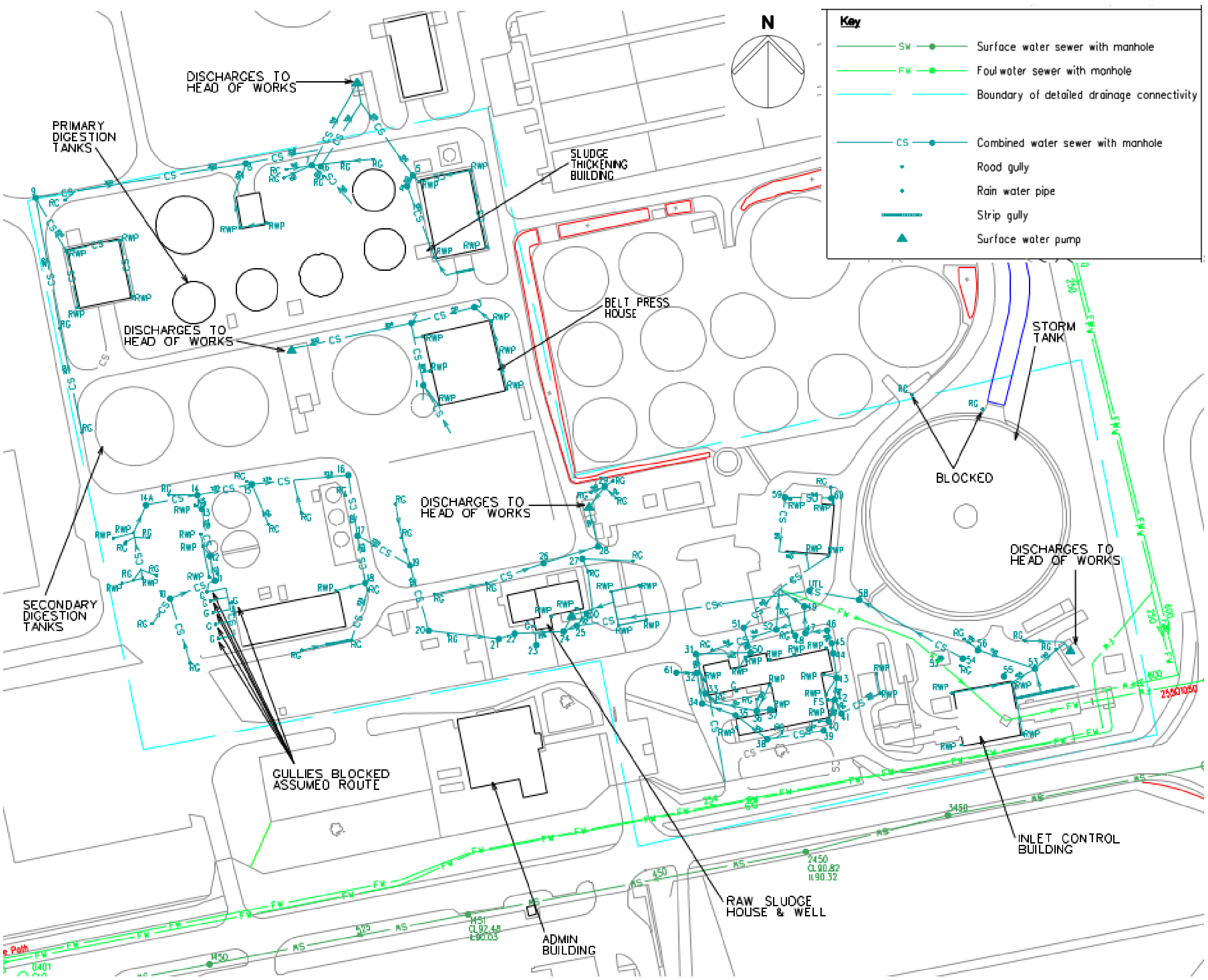


Figure 16: Drainage Plan

5.3 Liquor Returns

The existing liquor return system is not being altered by the containment system, other than the control modifications proposed in 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 for the sludge 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 automatically prevent any adverse impact on sewage treatment.

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, the drainage lines within the containment area 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.

.

6. Conclusions

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

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.

The assessment focuses on site-specific risks and outlines the options available for providing secondary containment of a catastrophic tank or digester failure.

The preferred containment option is Option 1 wide area containment with a storage lagoon as outlined in Section 4.1.1. This option will require the construction of 350m of low bund walls (250 - 1080mm high) around the wide containment area, two ramps at road crossings and one floodgate where the spill depth is greater than 300mm at access road. A storage lagoon 30m x 50m is required to limit the depth in the containment area. Whilst Option 2 has lower capital value, the intermediate terrace containment walls present a long-term low barrier to operation's pedestrian routes. Whilst this can be managed by step-overs, the balance of disruption to everyday activities is not ideal. Option 1 eliminates the requirement to manage the impediment.

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. Existing gravelled and grass areas within the containment will be replaced with concrete.

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. Due to gradients across the site, the containment bund wall height will be between 250 and 1080mm. The volume for containment is driven by the 25% rule.

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 Swindon STW

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 Swindon STW are as follows:

Source – There are two sources that have been identified:

1. Digestate is stored within the tanks
2. Polyelectrolyte chemicals for sludge thickening.

The Source Hazard rating was determined as High.

Pathway – There are two pathways that have been identified:

1. Site Drainage in area of tanks pump 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. Most of the STC area of site is on Flood Zone 1 but 3 no. Tanks sit within Flood Zone 2 boundary

The site inventory has a runoff time of 15 minutes if unconstrained.

Consequently, the Pathway Hazard rating was determined as Medium.

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

1. The site is located within 1000m of high-quality waters (River Ray)
2. The Sludge Treatment Centre is approximately 400m away from residential dwellings
3. Several businesses are located along Barnfield Road which less than 250m from the Sludge Treatment Centre for Swindon.

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.