



STALLINGBROUGH

# BUNDED TANK ASSESSMENTS

Ref: RA/Tanks/001

| Review History  |   |             |
|-----------------|---|-------------|
| <i>Issue n°</i> | <i>Purpose of revision</i>                            | <i>Date</i> |
| 1               | Creation of the document                              | 26/07/2006  |
| 2               | Major changes to site – demolition project completion | 23/02/2016  |
|                 |   |             |

# Introduction

This document provides a reference for all the bunds and tanks at the Stallingbrough installation.

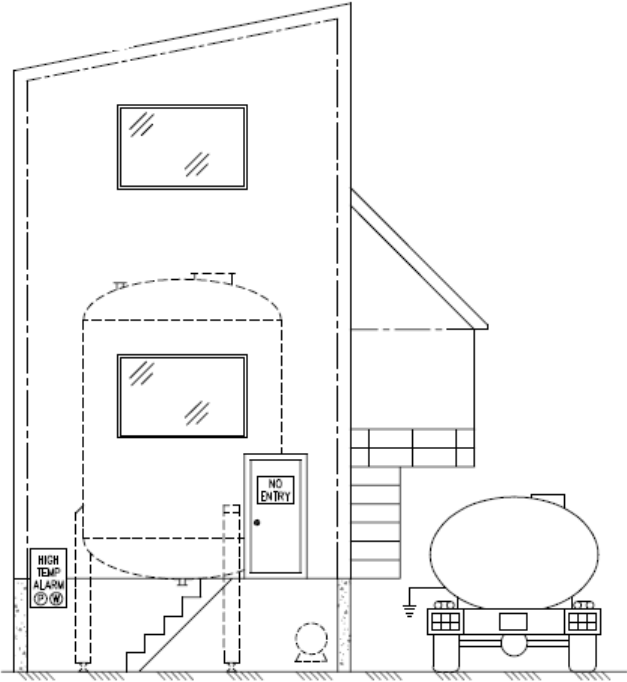
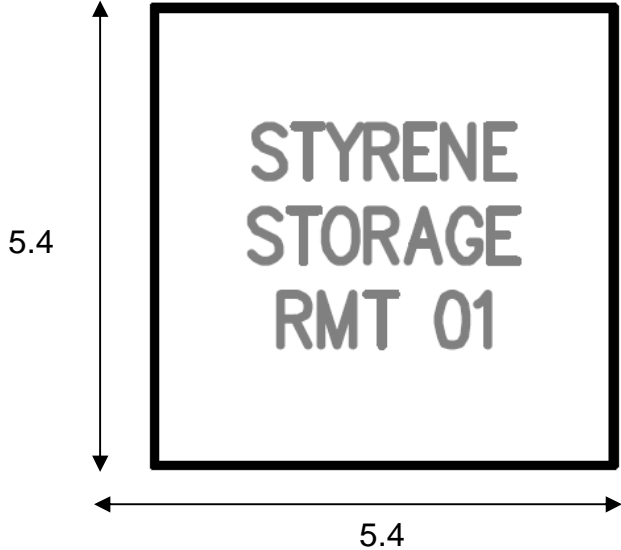
- All storage tanks at the Stallingbrough installation are bunded. These include the raw material storage tanks and finished product storage tanks and waste process tanks (BETP – not currently in use).
- Process tanks mixers are not bunded as they are transitional vessels and do not hold liquid for any significant length of time
- The whole site is tertiary bunded and all the drains are internal, going into interceptor tanks before being discharged from site, via cristal global. No drains discharge directly from site.
- All the tanks on site are above ground.
- All tanks have a percentage for ullage
- When considering the size of the bund, 110% of the capacity of the largest tank was used. In all cases 25% of the total storage volume was calculated and found to be less than the 110% of the largest tank

# Bund Guidelines

- Bunding is the method used to contain a liquid which has spilled or leaked from a vessel.
- The purpose of bunding is to:
  - Prevent the flammable liquid or vapour from reaching ignition sources;
  - Prevent the liquid entering the drainage or water systems where it may spread to uncontrolled ignition sources;
  - Allow the controlled recovery or treatment of the spilled material;
  - Minimise the surface area of the liquid and so reduce the size of any fire that may occur;
  - Prevent the spread of liquids which could present a hazard to other plant or personnel both on and off site;
  - Prevent contamination of land and water courses.
- The bund should have sufficient capacity to contain the largest predictable spillage.
- The bund capacity must be at least 110% of the capacity of the largest storage vessel within the bund.
- Smaller capacity bunds may be acceptable, where liquid can be directed to a separate evaporation area or impounding basin.
- Individual bunding is preferred to common bunding.

- The bund wall should have sufficient strength to contain any spillage or fire-fighting water.
- The bund wall should not be constructed too close to the tank.
- The design of the bund wall is a compromise between minimising the surface area of the liquid that might be spilled and minimising the height of the bund wall.
- The bund should be liquid tight.
- The floor of the bund should be concrete or another material substantially impervious to the liquid being stored.
- Surface water should not be allowed to collect in the bund.
- No combustible materials such as vegetation, litter or rubbish should be allowed to accumulate in the bund
- Pipe work should be routed within bunded areas with no penetration of contained surfaces.
- Where possible, have tanker connection points within the bund.
- Be subject to Regular inspection

# RMT 01



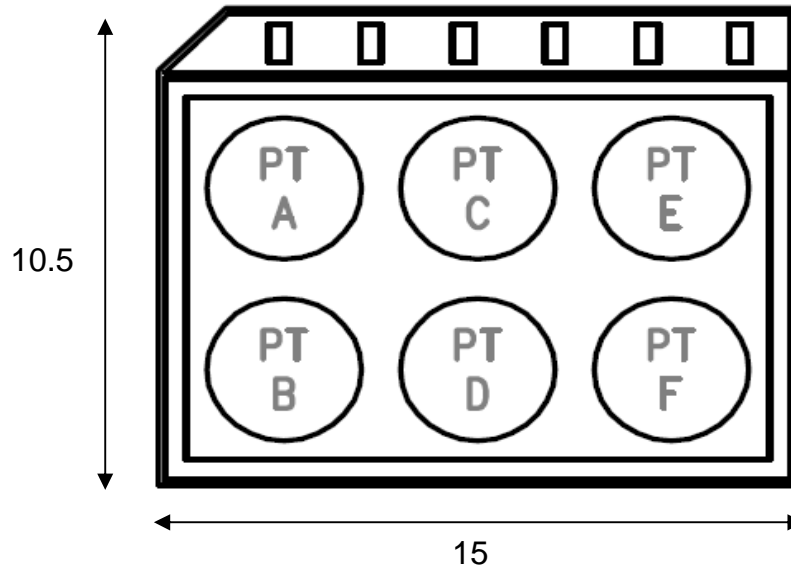
| BUND – RMT 01 |   |                              |      |                         |   |
|---------------|---|------------------------------|------|-------------------------|---|
| Dimensions m  | Refer to diagram  | Depth m                      | 1.52 | Capacity m <sup>3</sup> | 44.3  |
| Construction  | Concrete walls and base, bunded building  |                              |      |                         |   |
| Connections   | no pipe work penetrates the bund wall, there is a sump and pump that is used to empty rainwater on a regular basis. |                              |      |                         |   |
| Largest Tank  | 30m <sup>3</sup>  | Tank Capacity m <sup>3</sup> | 30   | 110%                    | Yes   |
| Condition     | Walls   | Good                         | Slab | Good                    | No Improvement required at this time. Continue to monitor |

# RMT 01

| Tank  | Contents        | Capacity m <sup>3</sup> | Operational Capacity T | Construction    | Safety Systems      | Transfer System   | Hazard                                    | Hazard Statements                                     |
|---|-----------------|-------------------------|------------------------|-----------------|---------------------|-------------------|---|---|
| RMT 01  | STYRENE MONOMER | 30                      | 30                     | Stainless Steel | PRP, SE, RG/U, IHLA | Pump TO & Pump TB | Flammable, Harmful, Toxic to Reproduction | H226, H304, H315, H319, H332, H335, H361d, H372, H412 |
| <b>Environmental Toxicity</b>   |                 |                         |                        |                 |                     |                   |   |   |
| <b>Harmful to aquatic organisms - may be dangerous for the aquatic environment if released.</b> |                 |                         |                        |                 |                     |                   |   |   |

TB – Transfer to building TO – Tanker offloading TM – Tank master SE – Static earth proving RG/U – Radar gauge/Ultrasonic LC – Load cells IHLA – Independent high level alarm PRP/V – Pressure relief valve on pump/vessel

# PT A-F



| BUND – PT A-F       |   |                                    |      |                               |  |
|---------------------|---|------------------------------------|------|-------------------------------|--|
| <b>Dimensions m</b> | Refer to diagram  | <b>Depth m</b>                     | 1.5  | <b>Capacity m<sup>3</sup></b> | 117  |
| <b>Construction</b> | Concrete walls and base, plinth, sloped channel for drainage  |                                    |      |                               |  |
| <b>Connections</b>  | no pipe work penetrates the bund wall, there is a sump and pump that is used to empty rainwater on a regular basis. |                                    |      |                               |  |
| <b>Largest Tank</b> | All tanks 100m <sup>3</sup>   | <b>Tank Capacity m<sup>3</sup></b> | 100  | <b>110% ?</b>                 | Yes  |
| <b>Condition</b>    | Walls   | Fair                               | Slab | Fair                          | No Improvement required at this time.<br>Continue to monitor |

# PT A-F

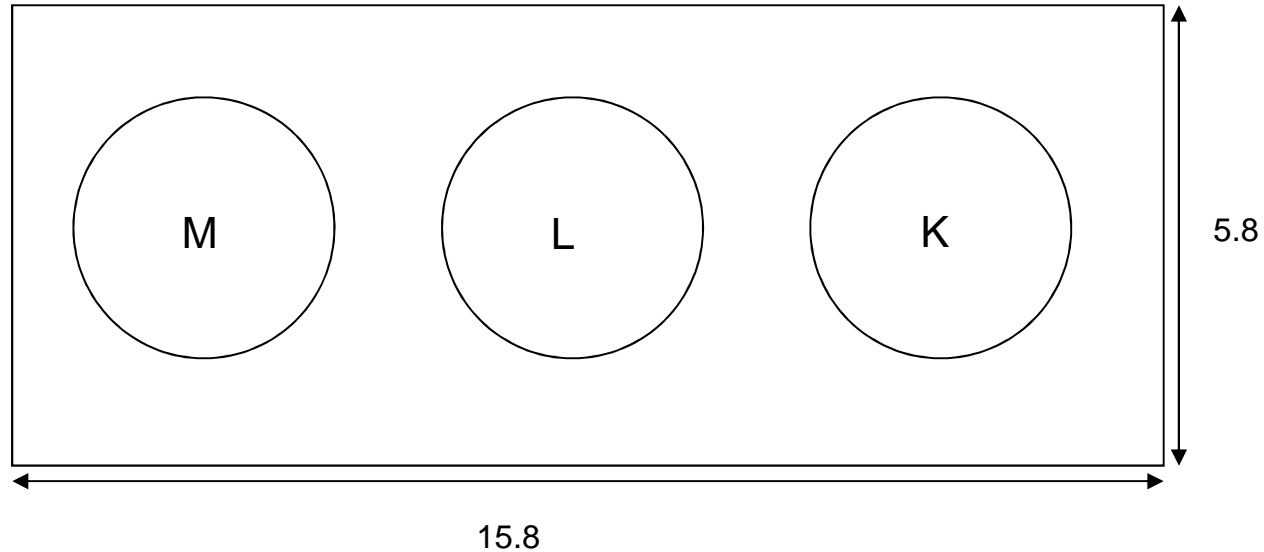
| Tank | Contents           | Capacity m <sup>3</sup> | Operational Capacity T | Construction    | Safety Systems         | Transfer System          | Hazard   | Risk Phases                               |
|------|--------------------|-------------------------|------------------------|-----------------|------------------------|--------------------------|--|---|
| PT A | UPR<br>IP13239     | 100                     | 92                     | Stainless Steel | PRP, SE, RG/U,<br>IHLA | Pressure TO &<br>Pump TB | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H319,<br>H335, H361d,<br>H372, H412 |
| PT B | UPR<br>IP66109     | 100                     | 92                     | Stainless Steel | PRP, SE, RG/U,<br>IHLA | Pressure TO &<br>Pump TB | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H319,<br>H335, H361d,<br>H372, H412 |
| PT C | UPR<br>IP61119     | 100                     | 92                     | Stainless Steel | PRP, SE, RG/U,<br>IHLA | Pressure TO &<br>Pump TB | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H319,<br>H335, H361d,<br>H372, H412 |
| PT D | <b>OUT OF LINE</b> | 100                     | 92                     | Stainless Steel | PRP, SE, RG/U,<br>IHLA | Pressure TO &<br>Pump TB | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H319,<br>H335, H361d,<br>H372, H412 |
| PT E | UPR<br>IP45120     | 100                     | 92                     | Stainless Steel | PRP, SE, RG/U,<br>IHLA | Pressure TO &<br>Pump TB | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H319,<br>H335, H361d,<br>H372, H412 |
| PT F | UPR<br>IP45121     | 100                     | 92                     | Stainless Steel | PRP, SE, RG/U,<br>IHLA | Pressure TO &<br>Pump TB | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H319,<br>H335, H361d,<br>H372, H412 |

## Environmental Toxicity

Harmful to aquatic organisms - may be dangerous for the aquatic environment if released.



# PT K,L,M



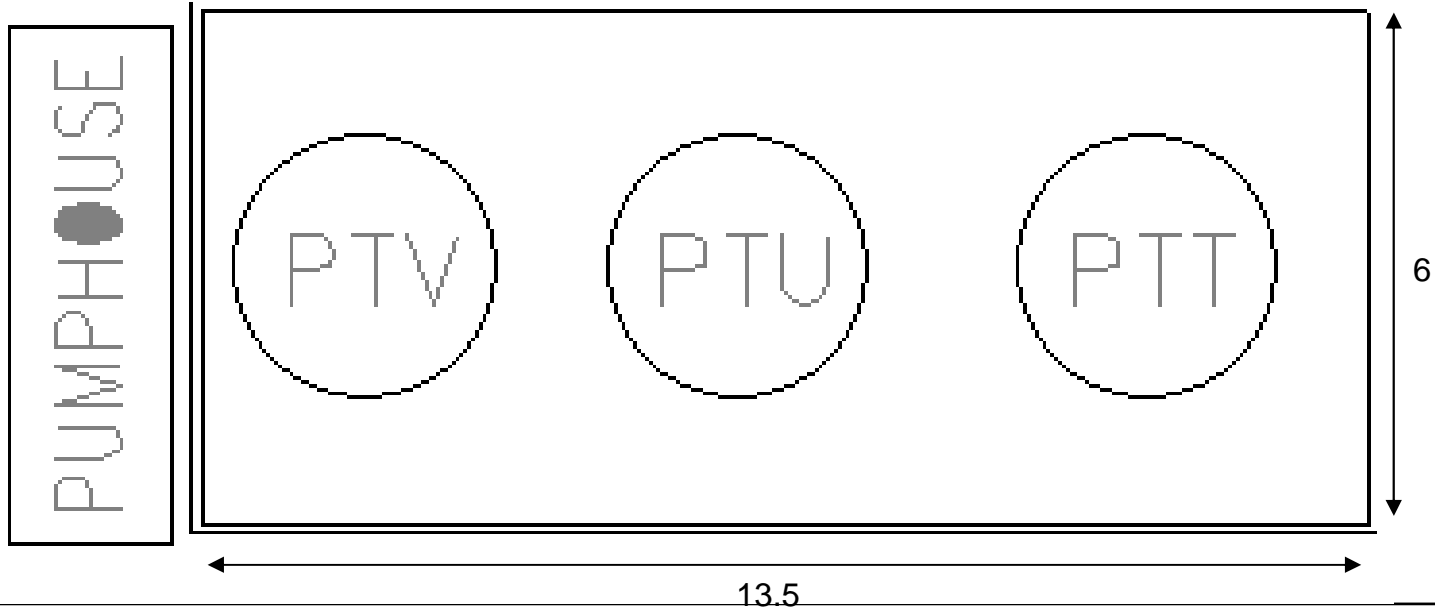
| BUND – KLM          |   |                                    |      |                               |  |
|---------------------|---|------------------------------------|------|-------------------------------|--|
| <b>Dimensions m</b> | Refer to diagram  | <b>Depth m</b>                     | 1.2  | <b>Capacity m<sup>3</sup></b> | 94   |
| <b>Construction</b> | Concrete walls and base, plinth, sloped channel for drainage  |                                    |      |                               |  |
| <b>Connections</b>  | no pipe work penetrates the bund wall, there is a sump and pump that is used to empty rainwater on a regular basis. |                                    |      |                               |  |
| <b>Largest Tank</b> | All 80m <sup>3</sup>  | <b>Tank Capacity m<sup>3</sup></b> | 80   | <b>110%</b>                   | Yes  |
| <b>Condition</b>    | Walls   | Fair                               | Slab | Fair                          | No Improvement required at this time.<br>Continue to monitor |

# KLM – ONLY K & M ARE CURRENTLY OPERATIONAL

| Tank   | Contents       | Capacity m <sup>3</sup> | Operational Capacity T | Construction    | Safety Systems | Transfer System | Hazard   | Hazard Statements                                  |
|--|----------------|-------------------------|------------------------|-----------------|----------------|-----------------|--|--|
| K  | UPR<br>IP25246 | 80                      | 70                     | Stainless steel | IHLA           | Pump            | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H315,<br>H319, H335,<br>H361d, H372,<br>H412 |
| L  | OUT OF<br>LINE | 80                      |                        | Stainless steel |                |                 |  |  |
| M  | IP61115        | 80                      | 70                     | Stainless steel | IHLA           | Pump            | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H315,<br>H319, H335,<br>H361d, H372,<br>H412 |
| <b>Environmental Toxicity</b>  |                |                         |                        |                 |                |                 |  |  |
| Harmful to aquatic organisms - may be dangerous for the aquatic environment if released. |                |                         |                        |                 |                |                 |  |  |

TB – Transfer to building TO – Tanker offloading TM – Tank master SE – Static earth proving RG/U – Radar gauge/Ultrasonic LC – Load cells IHLA – Independent high level alarm PRP/V – Pressure relief vale on pump/vessel

# PT T,U,V



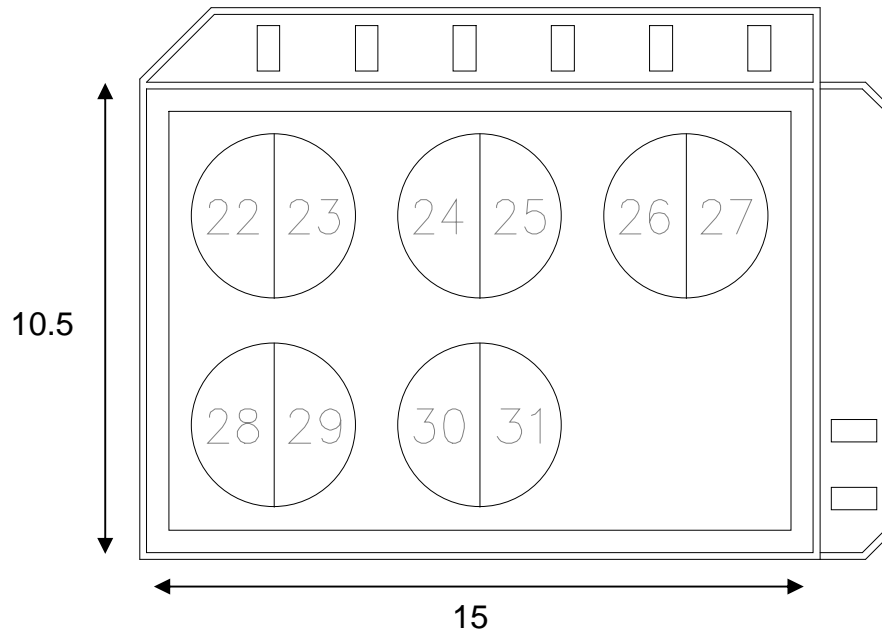
| BUND – PTT - V      |   |                                    |      |                               |  |
|---------------------|---|------------------------------------|------|-------------------------------|--|
| <b>Dimensions m</b> | Refer to diagram  | <b>Depth m</b>                     | 1.15 | <b>Capacity m<sup>3</sup></b> | 58   |
| <b>Construction</b> | Concrete walls and base, plinth, sloped channel for drainage  |                                    |      |                               |  |
| <b>Connections</b>  | no pipe work penetrates the bund wall, there is a sump and pump that is used to empty rainwater on a regular basis. |                                    |      |                               |  |
| <b>Largest Tank</b> | PTT - V   | <b>Tank Capacity m<sup>3</sup></b> | 50   | <b>110%</b>                   | Yes  |
| <b>Condition</b>    | Walls   | Fair                               | Slab | Fair                          | No Improvement required at this time.<br>Continue to monitor |

# PT T-V

| Tank   | Contents        | Capacity m <sup>3</sup> | Operational Capacity T | Construction | Safety Systems | Transfer System | Hazard   | Hazard Statements                                  |
|--|-----------------|-------------------------|------------------------|--------------|----------------|-----------------|--|--|
| PTT  | UPR<br>IP18125  | 55                      | 50                     | Carbon Steel | PRP, RG/U      | Pump TO & TB    | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H315,<br>H319, H335,<br>H361d, H372,<br>H412 |
| PTU  | UPR<br>IP 92223 | 55                      | 50                     | Carbon Steel | PRP, RG/U      | Pump TO & TB    | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H315,<br>H319, H335,<br>H361d, H372,<br>H412 |
| PTV  | UPR<br>IP15239  | 55                      | 50                     | Carbon Steel | PRP, RG/U      | Pump TO & TB    | Flammable,<br>Harmful,<br>Toxic to<br>Reproduction | H226, H315,<br>H319, H335,<br>H361d, H372,<br>H412 |
| <b>Environmental Toxicity</b>  |                 |                         |                        |              |                |                 |  |  |
| Harmful to aquatic organisms - may be dangerous for the aquatic environment if released. |                 |                         |                        |              |                |                 |  |  |

TB – Transfer to building TO – Tanker offloading TM – Tank master SE – Static earth proving RG/U – Radar gauge/Ultrasonic LC – Load cells IHLA – Independent high level alarm PRP/V – Pressure relief valve on pump/vessel

# HT22-31 – out of line



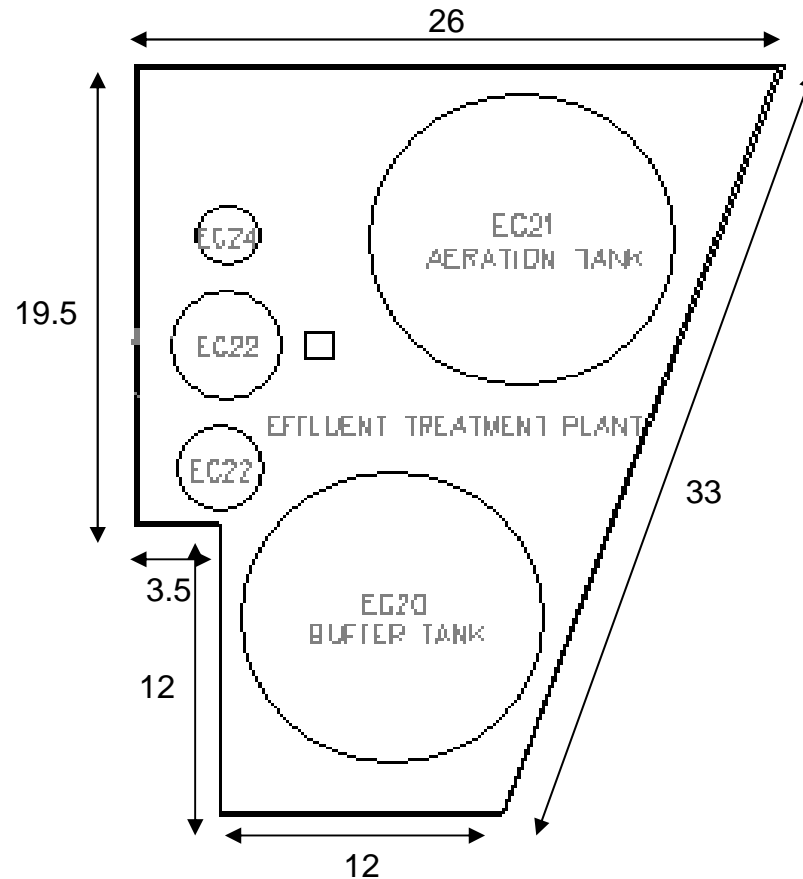
| <b>BUND – HT 22 – 31</b> |   |                                    |     |                               |     |
|--------------------------|---|------------------------------------|-----|-------------------------------|-----|
| <b>Dimensions m</b>      | Refer to diagram  | <b>Depth m</b>                     | 1.5 | <b>Capacity m<sup>3</sup></b> | 134 |
| <b>Construction</b>      | Concrete walls and base, plinth, sloped channel for drainage  |                                    |     |                               |     |
| <b>Connections</b>       | no pipe work penetrates the bund wall, there is a sump and pump that is used to empty rainwater on a regular basis. |                                    |     |                               |     |
| <b>Largest Tank</b>      | All tanks 50m <sup>3</sup>  | <b>Tank Capacity m<sup>3</sup></b> | 50  | <b>110%</b>                   | Yes |

# HT22-31 – out of line

| Tank | Contents | Capacity m <sup>3</sup> | Operational Capacity T | Construction    | Safety Systems | Transfer System | Hazard | Risk Phases |
|------|----------|-------------------------|------------------------|-----------------|----------------|-----------------|--------|-------------|
| HT22 | empty    | 50                      | 49                     | Stainless Steel |                |                 |        |             |
| HT23 | empty    | 50                      | 49                     | Stainless Steel |                |                 |        |             |
| HT24 | empty    | 50                      | 44                     | Stainless Steel |                |                 |        |             |
| HT25 | empty    | 50                      | 45                     | Stainless Steel |                |                 |        |             |
| HT26 | empty    | 50                      | 47                     | Stainless Steel |                |                 |        |             |
| HT27 | empty    | 50                      | 47                     | Stainless Steel |                |                 |        |             |
| HT28 | empty    | 50                      | 47                     | Stainless Steel |                |                 |        |             |
| HT29 | empty    | 50                      | 47                     | Stainless Steel |                |                 |        |             |
| HT30 | empty    | 50                      | 47                     | Stainless Steel |                |                 |        |             |
| HT31 | empty    | 50                      | 47                     | Stainless Steel |                |                 |        |             |

TB – Transfer to building TO – Tanker offloading TM – Tank master SE – Static earth proving RG/U – Radar gauge/Ultrasonic LC – Load cells IHLA – Independent high level alarm PRP/V – Pressure relief vale on pump/vessel

# Effluent Treatment – **SYSTEM CURRENTLY NOT IN USE**



| BUND – Effluent Treatment |   |                                    |                  |                               |                  |
|---------------------------|---|------------------------------------|------------------|-------------------------------|------------------|
| <b>Dimensions m</b>       | Refer to diagram  | <b>Depth m</b>                     | 1.2              | <b>Capacity m<sup>3</sup></b> | 377              |
| <b>Construction</b>       | Concrete walls and base, no plinth, sloped for drainage   |                                    |                  |                               |                  |
| <b>Connections</b>        | All tanker connections are within the bund, no pipe work penetrates the bund wall, there is a sump and pump that is used to pump rainwater into the buffer tank on a regular basis. |                                    |                  |                               |                  |
| <b>Largest Tank</b>       | EC21 Aeration Tank  | <b>Tank Capacity m<sup>3</sup></b> | SEE NEXT 4 PAGES | <b>110%</b>                   | SEE NEXT 4 PAGES |

# Maximum Spillage Potential From Effluent Tanks

- The tanks are made up of fibre glass sections each of 1.4 m height. The tanks are three panels high giving a total height of 4.2m. EC21 has an overflow at the join between the second and third panels and as such runs at 2/3rds maximum capacity under normal operating conditions.
- The diameter of tank EC20 is 11.8m - giving a total volume of 460m<sup>3</sup>
- The diameter of tank EC21 is 14.3m - giving a total volume of 676m<sup>3</sup>
- There are several conceivable failure modes for the tanks.
  - 1. A failure in the top section of the tanks
  - 2. A failure in the middle section of the tanks
  - 3. A failure in the bottom section of the tanks
  - 4. A failure of the pump timer on EC20 resulting in the total contents being pumped to EC21.
- (N.B there is no pump on EC21 so the contents cannot be pumped out due to a failure)
- Depending on the height of the failure and the tank which fails there are varying volumes of liquid that could be spilt. Each of these failures will be considered in turn and the volume of a potential spill calculated. The volume of each spillage will be calculated using the volume of a cylinder with the height being the depth of the panel sides.



# Failure Modes of Tank EC20 – Maximum volume 460m<sup>3</sup>

- Failure in top level of tank (assuming full to capacity) –  
Spillage potential 1/3<sup>rd</sup> of total volume = 153m<sup>3</sup>
  - Available bund volume 377m<sup>3</sup> – >110% of potential spillage
- Failure in middle section of tank (assuming full to capacity)  
– Spillage potential 2/3<sup>rd</sup>s of total volume = 306m<sup>3</sup>
  - Available bund volume 377m<sup>3</sup> – >110% of potential spillage
- Failure in bottom section of tank (assuming full to capacity)  
– Spillage potential total volume = 460m<sup>3</sup>
  - Available bund volume = 377m<sup>3</sup> + 131m<sup>3</sup> = 508m<sup>3</sup> – >110% of potential spillage
- The additional volume is created due to the fact that a spillage from the bottom layer would equalise out once the level in the bund reached that of the remaining liquid in the tank.

# **Failure Modes of Tank EC21 – Maximum volume 676m<sup>3</sup> – Normal capacity due to overflow pipe is 2/3<sup>rds</sup> of this**

- Failure in top level of tank – Spillage potential – None, due to the normal operating level of the tank being at the top of the second level.
- Failure in middle section of tank – Spillage potential ½ of volume within tank = 225m<sup>3</sup>
  - Available bund volume 377m<sup>3</sup> – >110% of potential spillage
- Failure in bottom section of tank– Spillage potential volume = 450m<sup>3</sup>
  - Available bund volume = 377m<sup>3</sup> + 192m<sup>3</sup> = 524m<sup>3</sup> - >110% of potential spillage
  - The additional volume is created due to the fact that a spillage from the bottom layer would equalise out once the level in the bund reached that of the remaining liquid in the tank.

## **Failure Modes of Tank EC21 – Maximum volume 676m<sup>3</sup> – Normal capacity due to overflow pipe is 2/3rds of this**

- The final failure mode would be if the timer for the transfer pump from EC20 failed and pumped the contents of EC20 in to EC21.
- This could potentially pump 460m<sup>3</sup> material into EC21.
- Working volume in EC21 = 450m<sup>3</sup>, remaining volume is 226m<sup>3</sup>, therefore the potential spillage from this failure would be 460m<sup>3</sup> (from EC20) – 226m<sup>3</sup> (volume that could be contained within EC21) = 236m<sup>3</sup> – This is also within 110% of the free capacity of the bund

# Effluent Treatment

| Tank | Contents            | Capacity m <sup>3</sup> | Operational Capacity T | Construction      | Safety Systems | Transfer System | Hazard           | Risk Phases      |
|------|---------------------|-------------------------|------------------------|-------------------|----------------|-----------------|------------------|------------------|
| EC20 | Buffer Tank         | 460                     | Between 200 and 375    | Fibreglass panels | IHLA           | Pump            | Could be harmful | Could be harmful |
| EC21 | Aeration Tank       | 676                     | Approx 450             | Fibreglass panels |                | Gravity         | Could be harmful | Could be harmful |
| EC22 | Sludge Tank         | 24                      | 20                     | Fibreglass panels | IHLA           | Pump            | Could be harmful | Could be harmful |
| EC23 | Settlement Tank     | 40                      | 30                     | Fibreglass panels | IHLA           | Pump            | Could be harmful | Could be harmful |
| EC24 | Final Effluent Tank | 14                      | 7                      | Fibreglass panels | IHLA           | Pump            | Could be harmful | Could be harmful |

TB – Transfer to building TO – Tanker offloading TM – Tank master SE – Static earth proving RG/U – Radar gauge/Ultrasonic LC – Load cells IHLA – Independent high level alarm PRP/V – Pressure relief valve on pump/vessel