Robert Wiseman Dairies
Solstice Park Amesbury

Type of System: Stormwater Soakaway
Date of installation: June 2009
Tank sizes: Tank 1: 9.05m x 25.05m x 2.05m = 464.7m³
Tank 2: 9.05m x 16.05m x 2.05m = 297.7m³
Tank 3: 8.05m x 20.05m x 2.05m = 330.8m³
Tank 4: 10.05m x 18.05m x 2.05m =371.8m³
Tank 5: 4.05m x 16.05m x 2.05m = 133.2m³
Tank 6: 2.05m x 8.55m x 1.8m = 31.5m³
Tank 7: 2.05m x 2.55m x 1.8m = 9.4m³
Tank 8: 3.05m x 4.05m x 0.8m = 9.8m³

Site Problem:

A 36500m² plot on Solstice Park Industrial Estate was to become the main distribution centre for a national dairy company. Restrictions on site discharge led to the development of an alternative drainage solution that would not rely on traditional sewerage systems. After consultations with the design team and the site engineer it was decided that a number of soakaway tanks across the site would be the most ideal solution. These tanks would collect and discharge stormwater back into the surrounding ground, mimicking the natural processes of the site before development.

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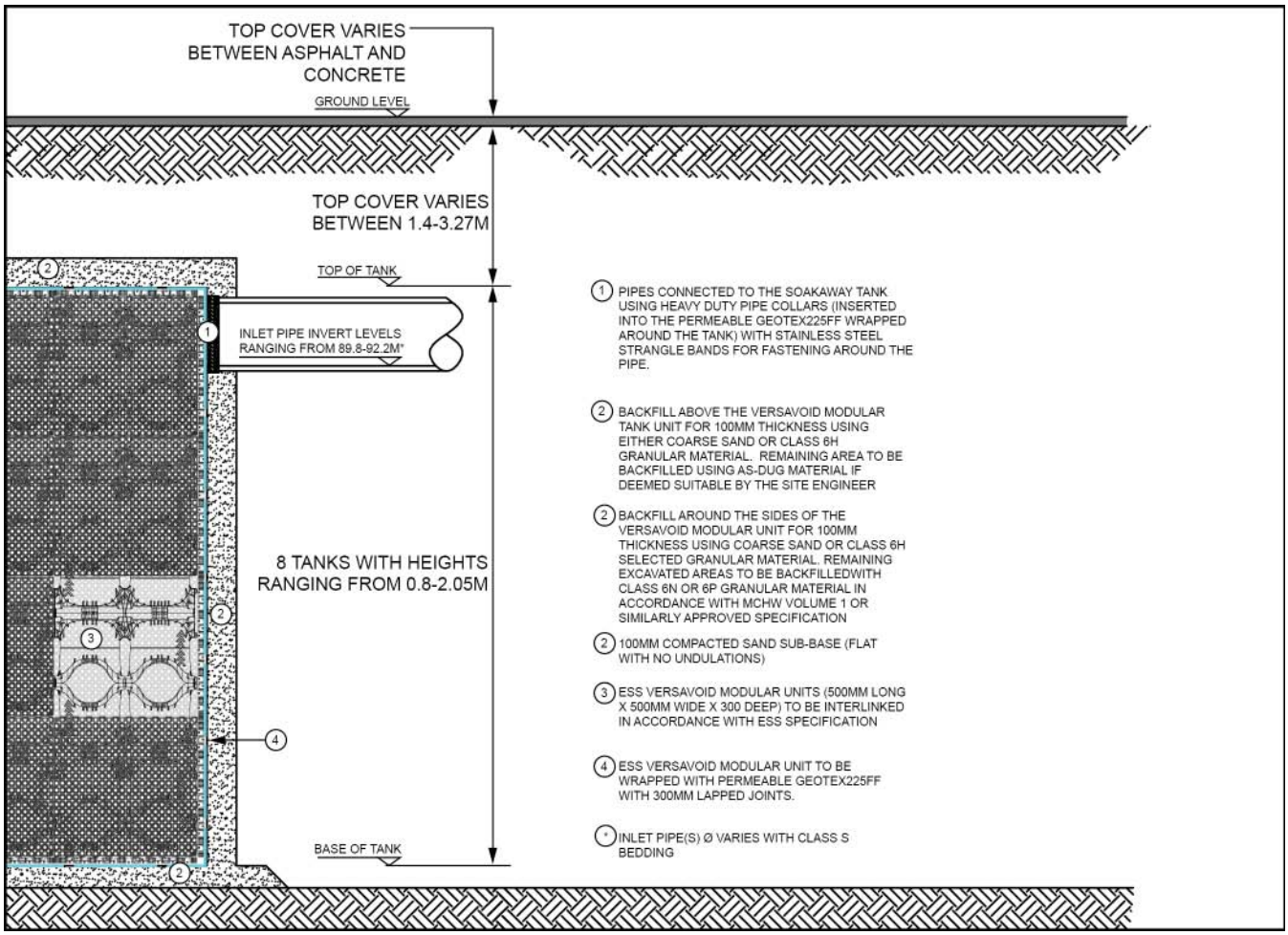

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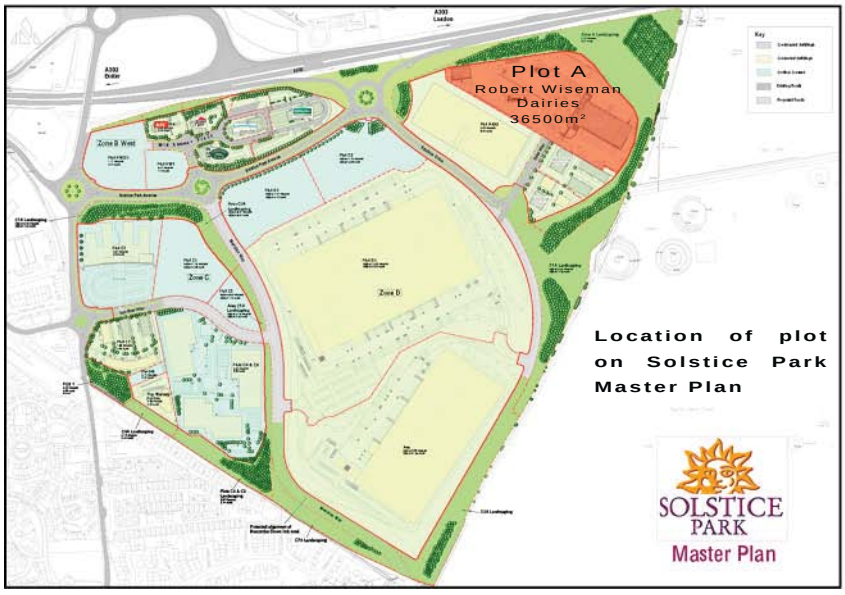
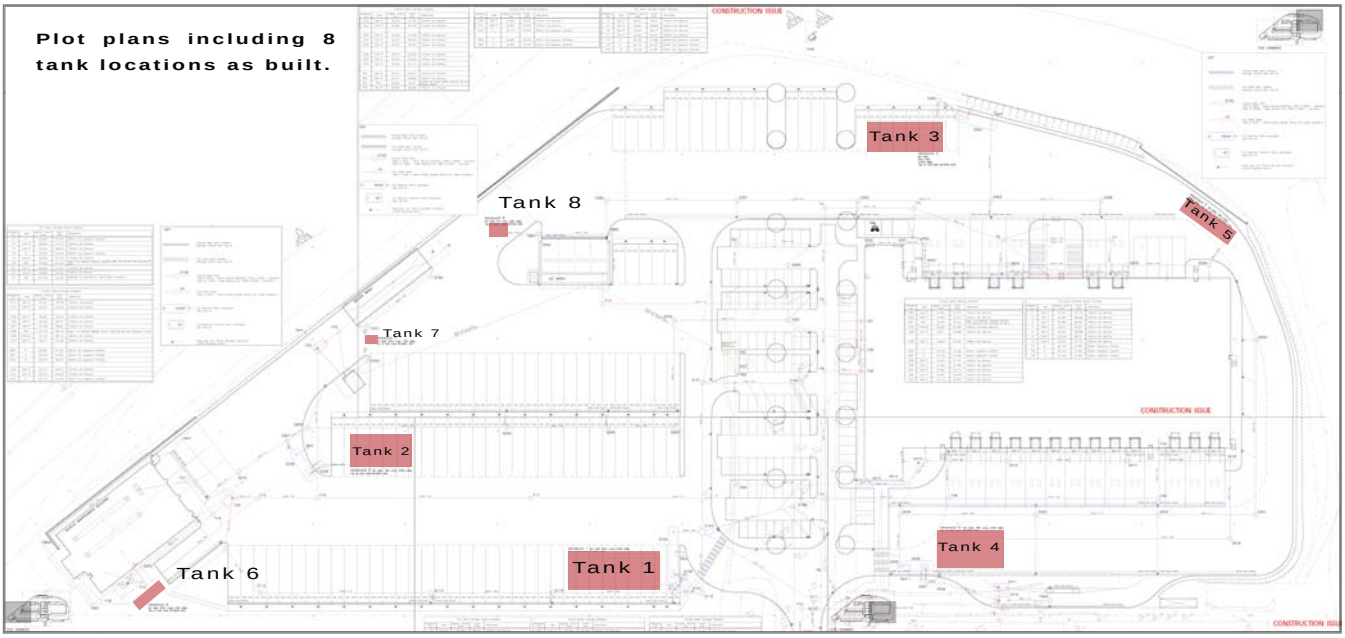
Project Requirements:

The site was mainly occupied by the central dairy plant and distribution centre with many subsidiary buildings for vehicle fleet maintenance located across the site. The area in between provided road infrastructure for both private staff vehicles and the company's large HGV fleet. The size of the site combined with the need for a structural loading solution led to a special consideration of soakaway volumes. Volumes needed to be sufficiently sized to provide adequate storage whilst also being strong enough to withstand heavy HGV loading. The project engineers were keen to see that these issues had been properly investigated, through the use of loading calculations (in line with appropriate guidance documentation).

Above: One of the larger tank installations



Location of plot on Solstice Park Master Plan



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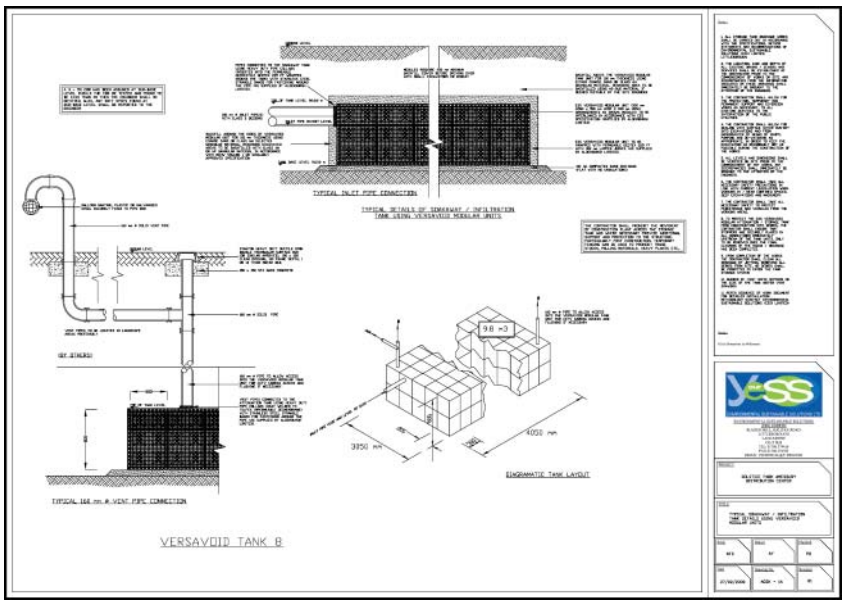
ESS Solution:

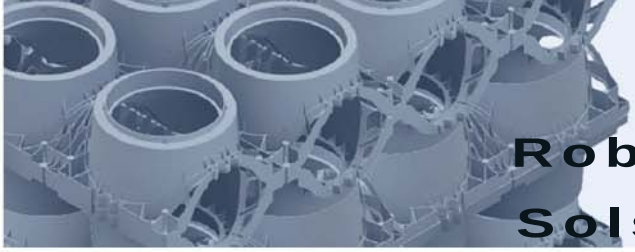
ESS specified a modular VersaVoid tank to provide a completely open, unified tank structure. Once installed, the VersaVoid tanks were completely accessible and could be easily accessed for later inspection/maintenance (if necessary).

In comparison to other available systems, VersaVoid was more than structurally capable. Its 320kN/m² loading strength and 120kN/m² lateral strength presented a very attractive stormwater solution. The combined package made VersaVoid the immediate choice for specification, so much so that VersaVoid was specifically selected by Robert Wiseman Dairies.



Each tank was individually specified according to the requirements of the local surroundings. Consideration was given to depth of top cover, loading requirements (applicable to all tanks) and inspection access.

The installed volume of the 8 tanks across the site totalled 1649m³, which at 95% void provided a massive 1566m³. The high void ratio provided almost as much net storage volume as the total gross installation volume making VersaVoid a very economical option. On top of this, the VersaVoid installation times were much more competitive than other systems.



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Special Considerations: HGV Loading Calculations

VersaVoid is regularly tested by two independent institutions. All tests undertaken (including compressive strength, lateral strength and long term creep tests) comply with CIRIA guidelines as outlined in CIRIA C609/697 and following defined testing methodology outlined in C680. The wide array of independent test data was enough to convince the engineer of VersaVoid's loading capabilities, however there was still a requirement to meet specific site loading requirements.

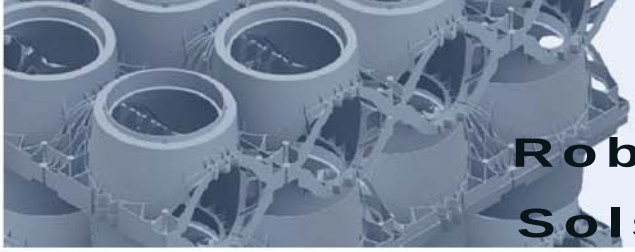
Table 4.2 Characteristic loads for different land use

Site use	Typical vehicles	DIN 1072 classification	Distributed load (kN/m²)	Concentrated load from wheels (kN)	Tyre contact area (mm)	Dynamic factor (optional) depends on speed of vehicles and amount of turning and braking	Material factors for creep/fatigue (serviceability limit state)	Comments
Small gardens or landscaped areas	No vehicles	None	None	None	None	None	1.0-1.5	Cover sufficient to prevent physical damage by excavation
Landscaped area where drive on mowers used	Drive on mower	None	5	1.4	150 × 150	1.0	1.0-1.5	
Driveways to individual houses and car parks with height barriers to limit vehicle size	Cars up to 3000 kg GVW (eg people carrier)	3/3	5	10	200 × 200	1.0	1.25-1.5	
Car parks with no height barriers, occasional light delivery vehicles	Cars or light vans up to 6000 kg GVW	6/6	5	20	200 × 200	1.0-1.25	1.5	
Car parks	Cars or light delivery vehicles up to 9000 kg GVW	9/9	5	30	200 × 280	1.0-1.5	1.5	
Car parks, light access roads	Vehicles up to 12 000 kg GVW	12/12	10	40	200 × 300	1.0-1.5	1.5	
Car parks, mews, HGV parks etc	Vehicles up to 16 000 kg (eg rigid small to medium fire engines)	16/16	10	50	200 × 400	1.0-1.5	1.5	
HGV parks, access or small estate roads (<15mph)	Vehicles up to 30 000 kg GVW (eg eight wheel bin lorry)	30/30	10	50	200 × 400	1.0-1.5	1.5	
Low speed rows (<15mph)	Vehicles up to 60 000 kg GVW (eg articulated lorries)	60/30	10	100	200 × 600	1.0-2	1.5	
Full HA loading for main roads	HGVs up to 44 000 kg GVW	None	10	100	266 × 266	1.0	1.5	Dynamic performance of geocellular units used below main roads should be fully understood based on full-scale field trials.

VersaVoid's loading capability allowed for maximum legal loading across the site as defined by CIRIA C680, seen in the extract from p.54.

ESS testing via independent testing facilities at CERAM carried out to C680 guidelines.

On site, cover depths varied between tanks, ranging from 1.4-3.27m. Deep cover depths can cause problems for some systems as they become subjected to reduced transient loading allowances as a result of the already imposed loading of the cover material. As a result they cannot be safely installed beneath roads and load bearing areas. On the other hand VersaVoid is capable of bearing the full 10 tonne load allowed on British roads (identified in C680 as full HA loading for main roads) with cover from as little as 0.6m to as much as 5m. This meant that none of the eight tanks restricted HGV traffic access and the site stayed completely accessible and suitable to the company's needs.



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Special Considerations: HGV Loading Calculations Continued...

To further satisfy the engineers requirements, loading calculations were provided for each of the eight stormwater tanks that clearly identified the type and depth of top cover as well as the maximum loading taken from the tyre footprint of a laden HGV. Each test proved that VersaVoid's loading figures were more than enough to carry the heaviest legal loads and so were approved for installation across the site beneath road and parking areas.

Project : Solstice Park Amesbury Distribution Center (TANK 7)

Load Distribution on Versavoid Modules

Compressive strength of Versavoid modules

Compressive strength of Versavoid modules = 8.25 tons
= 80.9325 KN
= 323.73 kN/m^2

Partial factor of safety for materials (F_m) = 2.75
Considering Limit state design methods can be used to design the tanks (CIRIA C609)

Allowable load on Versavoid modules = **117.72 kN/m^2**

Weight of cover fill and surcharge load over Versavoid module

Weight of cover fill and surcharge load (σ_v) = **$(d\gamma) + (\sigma_{surcharge\ load})$**
Where,
d - is the depth of fill material over the modules, m
y - is the unit weight of fill material, kN/m^3
$\sigma_{surcharge\ load}$ - is the surcharge load, kN/m^2

Partial factor of safety for loads

Limit state	Vertical dead load (F_{dl})	Imposed live load (F_{ll})
Ultimate limit state	1.4	1.6

Unit weight soil = 21 kN/m^3

Depth of soil fill = 1.15 m

Unit weight Asphalt = 23.7 kN/m^3

Depth of Asphalt = 0.25 m

Load from each wheel = 10.200 tons

= 100.062 kN

Area of applied load on Versavoid modules

Considering the soil is well compacted, the load distribution to be 45^0

Depth of cover on the modules = 1.4 m

Considering the area of contact of the tyre and the road is 266 x 266 mm

The total area of load applied on the modules = 1.4 + 0.266 + 1.4 m

= 3.066 m

Contact area A' = **3.066 x 3.066 m**

Pressure applied on the Versavoid modules

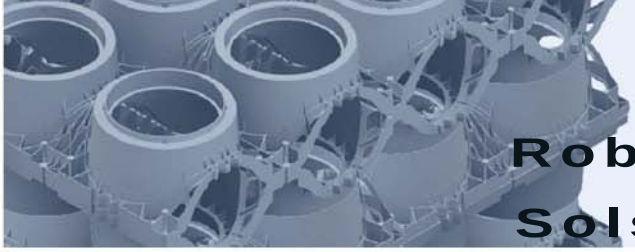
Pressure applied on the Versavoid modules = W F_d / A'
where,
W - is the wheel load, kN
F_d - is the dynamic factors to allow for the dynamic effects of the moving wheels
A' - Area of applied load on Versavoid modules

Pressure applied on the modules = 10.644 kN/m^2

σ_v (kN/m^2) = (21 x 1.15 x 1.4) + (23.7 x 0.25 x 1.4) + (10.644 x 1.6)

= **59.14 kN/m^2 < 117.72 kN/m^2**

Loading design is safe



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Summary:

- The combination of a high void ratio and excellent loading characteristics presented an ideal, economical solution to site discharge restrictions without compromising access to the site.
- Full test data provided independently (via two separate institutions) and following official methodology outlined in CIRIA C680 validated structural claims. Further on-site loading calculations ensured VersaVoid was entirely safe for each specific tank's loading circumstances.
- Due to VersaVoid's structural ability, the entire range of cover depths could be accommodated and all tanks were capable of carrying the full HA loading legally allowed on British roads.
- Modular configuration allowed each tank to be unique and work with its own local surroundings to best fit and work with the site.