



Proposed Retirement Housing

Windmill Street, Gravesend.

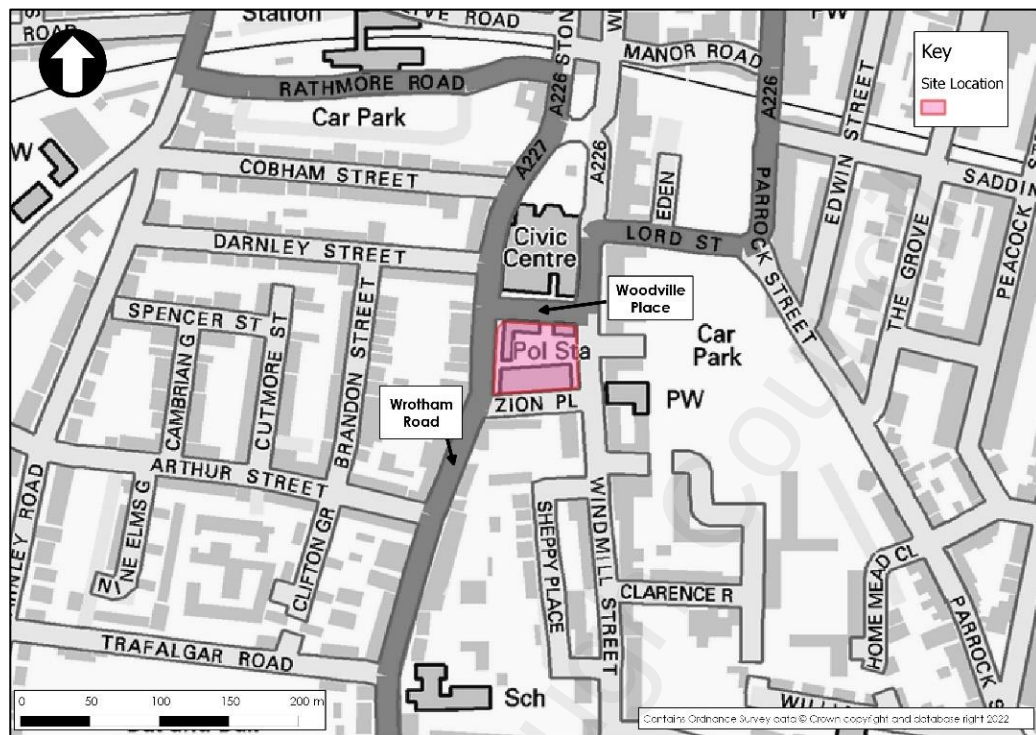
Flood Risk & Drainage Technical Note

Project No.	1305
Revision	Revision B
Date	12 April 2022
Client	Churchill Retirement Living
Prepared	J Blyth
Checked	C Yalden
Authorised	C Yalden
File Ref.	p:\1305 windmill street, gravesend\c documents\reports\1305 windmill street gravesend - fr+d.docx

1 Introduction

Introduction & Background

- 1.1 Awcock Ward Partnership has been commissioned by Churchill Retirement Living to prepare a Flood Risk and Drainage Technical Note in support of an Outline Planning Application at the former Gravesend Police Station at Windmill Street, Gravesend, Kent, DA12 1DB.
- 1.2 The development will consist of 75 self-contained retirement apartments over five storeys and one car park. The proposed mix includes 48 one-bedroom apartments and 27 two-bedroom apartments.
- 1.3 The site occupies a block of land bounded on all sides by adopted highway.
- 1.4 The location of the site in relation to its surroundings can be seen within Figure 1.1.

Figure 1.1 – Site Location

- 1.5 This Technical Note has been prepared in accordance with the National Planning Policy Framework (NPPF) and Kent County Council's (KCC) drainage guidance document 'The Kent Design Guide Making It Happen – Sustainability (drainage systems)' (KCC Design Guide). The Note sets out the existing baseline conditions, development proposals and the proposed Surface Water Management Plan and foul water strategy that will serve the development.

2 Existing Baseline Conditions

Existing Site

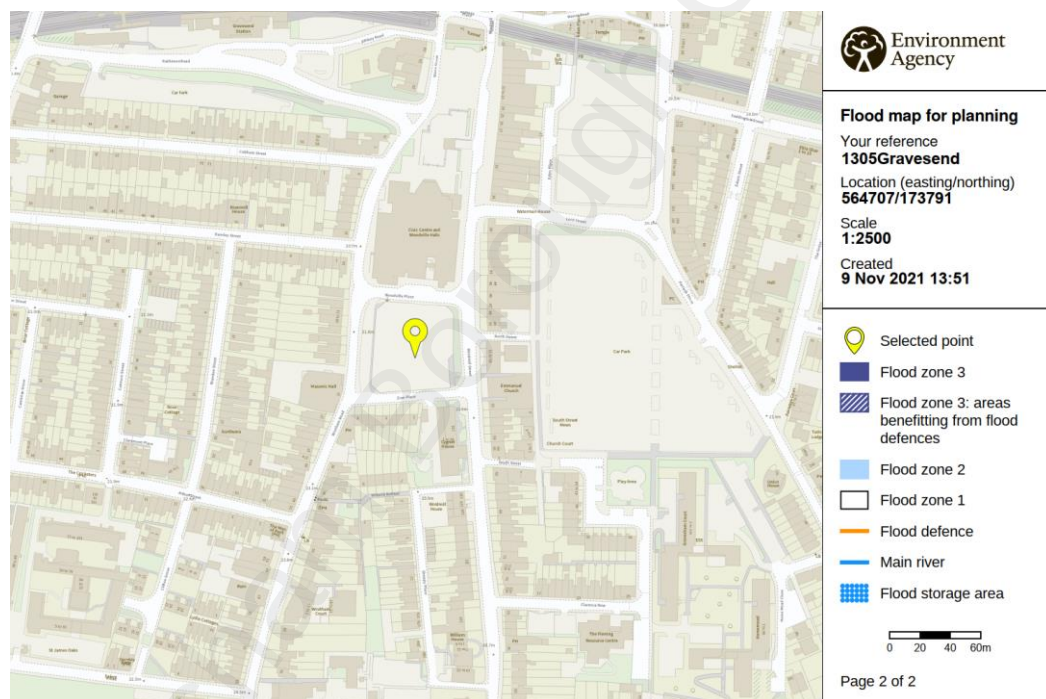
- 2.1 The existing brownfield site comprises a former Police Station Building and associated accesses and parking, with the site accessed from Woodville Place to the north. The former buildings occupying the site have been largely demolished leaving the external boundary wall (and presumably associated structure to support it) together with the internal paved courtyard.
- 2.2 The topographic survey confirms that the majority of the site is enclosed in the boundary wall. Outside the wall the areas of the site between the wall and the edge of the highway generally fall and drain to gullies in the highway.

- 2.3 Within the boundary the current surface is relatively flat and generally below highway level at circa 19.8mAOD. Pedestrian access to the existing site is via steps to the south-east.
- 2.4 A copy of the topographic survey for the site can be seen as Appendix A.

Existing Flood Risk

- 2.5 An extract of the 'Flood Map for Planning' has been reproduced as Figure 2.1 and shows the site as being entirely within 'Flood Zone 1', as land assessed as having less than 1 in 1,000 annual probability of flooding from fluvial sources (<0.1%).

Figure 2.1 – EA Flood Map for Planning



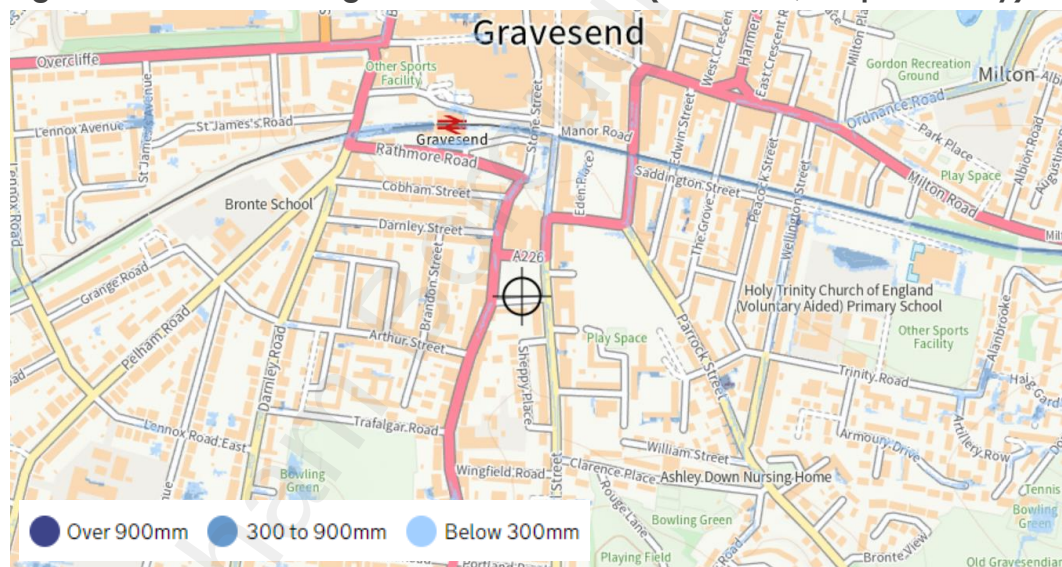
Pluvial sources (surface water flooding)

- 2.6 An extract of the EA's 'Flooding from Surface Water' map has been reproduced as Figure 2.2A (low risk) and Figure 2.2B (medium risk). The mapping is based on LIDAR data and indicates the typical conveyance routes of surface water runoff in up to the 1 in 1,000 year return period storm.
- 2.7 Low risk mapping indicates flooding during extreme events with a probability of occurrence up to 0.1%. Medium risk mapping indicates flooding for events with a probability of occurrence of between 33.3% and 1% and therefore equates to return period equivalent to the development design life of up to 100 years.

Figure 2.2A – EA Flooding from Surface Water (Low Risk, <0.1% probability)



Figure 2.3B – EA Flooding from Surface Water (Med. Risk, 1% probability)



- 2.8 The mapping indicates no on-site surface water flooding during low or medium risk events, therefore, the site is not at risk of flooding during its lifetime or during extreme events.
- 2.9 Minor surface water flooding is indicated in the highway network during the medium risk scenario, with depth below 300mm. The extent of surface water flooding in the highway network increases during the low risk scenario, but depths remain below 300mm. There are no major flow paths associated with these events local to the site, therefore, depths of flooding and velocities are unlikely to prevent access to the site during low and medium risk events.

2.10 The site does not lie within a groundwater flood risk area. The site is not located at the lowest elevation within the local area and therefore the site is not likely to be susceptible to groundwater flooding.

2.11 The site does not lie within the maximum extent of flooding from any reservoirs, either alone or in combination with river flooding, and there are no known on-site flood risks associated with infrastructure failure.

Ground Conditions

2.12 A ground investigation has been undertaken by Crossfield Consulting and concluded;

"The ground conditions comprise clays and silts (including matrix supported Grade Dm structureless chalk strata), which may preclude the use of shallow soakaway drainage. Due to the presence of potential soluble strata beneath the site, ground support conditions relating to the underlying chalk will need to be considered if an infiltration drainage solution is to be proposed and further investigation is recommended to provide additional data in this regard. Based on the available information, it would be prudent to identify an alternative drainage solution at this stage."

2.13 Extracts from the ground investigation can be found within Appendix B of this Technical Note.

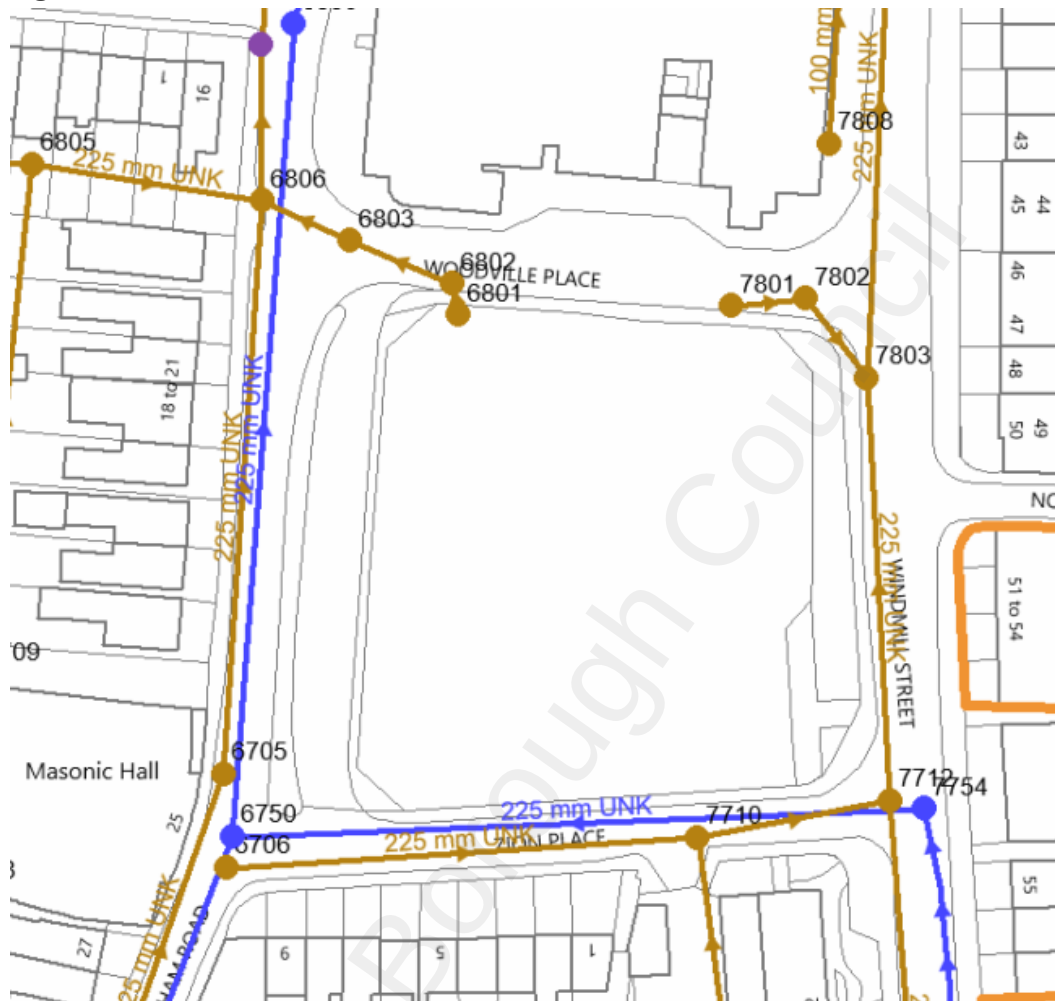
Existing Site Drainage

2.14 Southern Water's (SW) asset plans indicate the site is connected directly to the public foul network, with adopted chambers located on the site.

2.15 The mapping also indicates an adopted surface water sewer in Wrotham Road and Zion Place.

2.16 It is not known exactly how surface water from within the boundary wall drains, however, it is likely it either drains to the public foul or surface water network via on-site, unattenuated connections. The area of the site within the boundary wall is 2830m².

2.17 SW's sewer records plan can be found within Appendix C of this Technical note, with an extract included below as Figure 2.3.

Figure 2.3 – Southern Water Sewer Records

- 2.18 SW's records indicate the existing site connection with the public foul network has an invert of 20.63mAOD, at a depth of 0.75m below ground level.
- 2.19 The invert of the adopted chamber in the highway is 18.30mAOD at a depth of 2.91m below ground and therefore it is anticipated a gravity connection to the adopted foul network will be achievable.
- 2.20 The invert of the most local adopted surface water manhole is not directly available, but based on minimum gradients, and pipe sizes may lie between 20.08mAOD and 19.21mAOD. It may therefore be possible to discharge an attenuated flow from a belowground tank via a gravity connection to the public surface water sewer, but should this not be possible a private pumped connection would be feasible.
- 2.21 The invert of public surface water sewer local to the site should be verified prior to commencement to inform the detailed drainage design. Wherever practicable existing sewer connections should be retained to minimise off-site disruptions.

Existing surface water runoff

- 2.22 Runoff generated by the existing site would be limited by the existing drainage systems that discharge to the SW sewer network. Excess flows would overwhelm the system and may pond locally on site before routing off-site to the surrounding road network to the north.
- 2.23 'KCC Design Guide' states,
- "The total discharge from the site should aim to mimic greenfield rates. The discharge from the site should be restricted to the theoretical greenfield runoff rates for each of the 1, 30 and 100 year return period storms.*
- The acceptable calculation methods are specified in Ciria SuDS Manual, Report C753 (2015) or as updated. When greenfield rates calculations result in a total discharge from the site of less than 5 litres/second, a rate of 2 litres/second may be used."*
- 2.24 When considering brownfield sites 'KCC Design Guide' states,
- "If the greenfield runoff rate cannot be achieved, full justification should be made by the applicant to KCC. The final discharge rate should seek to provide betterment from the existing rate but should not exceed 50% of the existing rate for each of the critical rainfall event.*
- 1. the current discharge rate from the site at the time of the planning application; or*
- 2. the capacity of the current connection to the surface water system."*
- 2.25 KCC Design Guide places the following limits on control sizes'
- "The use of flow control devices such as weirs, pumps, orifice plates (hydrobrakes), etc. within a system to be adopted by Kent County Council will require approval.*
- Minimum size of hydraulic devices for unprotected controls shall usually be as follows:*
- 100mm for orifice plates*
 - 75mm for vortex control devices (and in accordance with manufactures recommendations)*
 - 150mm for throttle pipes. Throttle pipes should be less than 15m in length."*
- 2.26 The equivalent greenfield runoff rates for the site within the redline boundary have been calculated using ICP SuDS, with the results

summarised within Table 2.1 and the calculation sheet included within Appendix D of this report.

Table 2.1 – Equivalent Greenfield Runoff Rates

Return Period	Greenfield Rate (l/s)
1 year	0.7
30 years	1.8
100 years	2.6

- 2.27 It is proposed that any discharges to Southern Water sewers should be limited to greenfield rates as far as is practicable, up to a maximum of 50% of existing brownfield 1in1 year discharge rates.
- 2.28 By comparison, the sites existing brownfield discharge rates to the Thames Water network have been calculated using the Rational Method, based on an impermeable catchment of 0.283ha, within Hydrological Region 7 and with a rainfall intensity of 50.4mm/hr. The output from this calculation, including growth curve factors to estimate the 1, 30 and 100 year return periods can be seen within Table 2.2.

Table 2.2 – Brownfield Runoff Rates

Return Period	Brownfield Rate (l/s)
QBar	39.7
1 year	33.7
30 years	95.1
100 years	126.5

- 2.29 Given the proximity of an adopted surface water network in the highways bounding the site it is feasible the previous building and the associated hard standings discharge to more than one point on the adopted network. If this was not the case, it is likely the existing site drainage would be unsized for extreme events.
- 2.30 To present a worst case scenario, assuming a single point of connection for the existing site at a size of 150mm, with a gradient consistent with self-cleansing velocities, it is estimated the site may have been throttled to 17.8l/s by its connection to the public surface water network. In accordance with KCC Design Guidance, an upper limit for discharge from this site is therefore 8.9l/s.
- 2.31 A proposed controlled discharge of 5.0l/s would provide 72% betterment over the estimated throttled brownfield discharge rates based on a single 150mm site connection at a gradient of 1in100. This also ensures that the minimum 75mm vortex control, without fine screening, is not exceeded, as required by the 'KCC Design Guide'.

3 Development Proposal

- 3.1 The proposed development comprises redevelopment of the site to form 75 no. retirement apartments including communal facilities, access, car parking and landscaping. The proposed mix includes 48 one-bedroom and 27 two-bedroom apartments.
- 3.2 A copy of the proposed site layout has been included within Appendix E of this report.

4 Surface Water Management Plan

- 4.1 The site is less than 1ha and is located within Flood Zone 1, therefore a Flood Risk Assessment is not required. This technical note has been prepared to assess any relevant flood risks and drainage constraints and to identify an appropriate drainage strategy for the proposed development.
- 4.2 To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 100 year return period.
- 4.3 The strategy also safeguards against the upper end allowances for climate change (40%) providing betterment over existing conditions, where the rate and volume of runoff would continue to increase due to climate change.
- 4.4 The Crossfield Consulting ground investigation indicates that the brownfield site is underlain by solution sensitive strata and recommends consideration of a drainage strategy other than infiltration.
- 4.5 The current connection of the sites surface water is considered likely to be with the adopted public sewers local to the site.
- 4.6 There are no nearby watercourses, but adopted surface water sewers are mapped adjacent the site in Wrotham Road and Zion Place.
- 4.7 It is proposed that development runoff will be discharged to the existing SW surface water sewer in Wrotham Road. The attenuation of runoff will significantly reduce existing peak rates of discharge from current impermeable surfaces on site; and in line with 'KCC Design Guide', achieves 72% betterment (in excess of the minimum 50% betterment required for brownfield site) over the existing 1in1 year brownfield discharge rates.

- 4.8 Total development from roofs and accesses will be attenuated in a new cellular attenuation tank beneath the proposed car park/access.
- 4.9 All chambers immediately upstream of the tank will include silt traps, whilst the tank itself will include vented covers or a high-level vent pipe to mitigate air-locks.
- 4.10 Runoff from the tank will pass through a flow control chamber prior to discharging to surface water network under Wrotham Road. The control solution proposed on the drainage strategy is a hydrobrake with a peak discharge of 5.0l/s. However, should the invert of the surface water sewer be above the invert of the site discharge, then a pump control set at 5.0l/s would be necessary. A pre-development enquiry has been submitted to Southern Water for this connection.
- 4.11 The MicroDrainage source control module has been used to determine the storage requirements for the development. The output of this exercise has been summarised within Table 4.1, with copies of the modelling outputs included within Appendix F.

Table 4.1 – Attenuation Storage Volumes

Attenuation Feature	100yr +40% Attenuation Requirement
Cellular Tank	90.7 m ³

- 4.12 Beyond the 100-year critical storm, exceedance runoff will be directed towards any residual areas of open space and/or the proposed car park, where any aboveground capacity can be utilised. The level of external perimeters to the site including planting beds should be considered in relation to opportunities to retain exceedance on site, and limit exceedance flow off-site to lower ground.
- 4.13 Beyond the limits of the site, exceedance flows would continue to the surrounding road network, where flows are directed north.
- 4.14 The proposed development will provide a peak rate of discharge from the site of 5.0l/s, subject to capacity enquiries. Future connection to the existing public surface water network will provide 72% betterment compared to the existing 1in1 year brownfield site, estimated at 17.8l/s.
- 4.15 A copy of the preliminary drainage layout can be found on drawing 1305-01-PDL-1001 included within Appendix G.

Long-Term Storage

- 4.16 Long-Term Storage has been assessed in accordance with CIRIA C753 'The SuDS Manual'.
- 4.17 The proposed scheme layout does not increase the existing impermeable drained catchment (0.283ha) and will not increase the volume of runoff compared to existing brownfield conditions. It is therefore concluded that Long Term Storage is not required as part of this application.

5 Foul Water Strategy

- 5.1 Foul flows generated by the proposed development will drain through a new private gravity foul network and will discharge to the public foul sewer in Woodville Place, via the indicated adopted site connection.
- 5.2 The existing on-site foul connection will be retained wherever possible. If this is not possible due to existing levels, a new connection to the existing adopted foul invert in Woodville Place may be necessary.
- 5.3 The proposed foul drainage arrangements can be seen on the preliminary drainage layout drawing 1288-01-PDL-1001 within Appendix G.

6 Ownership & Maintenance

- 6.1 All on-site piped drainage will remain private and will be designed in accordance with Building Regulations Part H and will become the responsibility of the building operator.
- 6.2 The proposed attenuation will also be retained under private ownership and operated and maintained by an appointed management company in accordance with CIRIA C753 and any manufacturer specific guidance.
- 6.3 At the detailed design stage, a 'Drainage Maintenance Plan' will be prepared. The Plan will set out maintenance tasks, responsibilities and frequencies for the entire drainage network.

7 Conclusion

- 7.1 The proposed development has been assessed in line with the National Planning Policy Framework, to allow the planning application to be progressed and to show that the development can be undertaken in an acceptable manner from a flood risk perspective.
- 7.2 The proposed development is located within Flood Zone 1 and is not known to be susceptible to flooding from pluvial, groundwater, infrastructure or artificial sources.
- 7.3 To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 1 in 100 year return period.
- 7.4 The strategy also safeguards against climate change (40%), providing betterment over existing conditions, where the rate and volume of runoff would continue to increase due to climate change.
- 7.5 The existing ground conditions may be susceptible to solution features and therefore advice indicates drainage strategies should consider discharges other than by infiltration.
- 7.6 Storm water runoff will be attenuated on-site and will discharge via a new connection to the existing Southern Water surface water sewer beneath Wrotham Road.
- 7.7 The impermeable drained catchment is not being increased by the development, meaning Long Term Storage is not required.
- 7.8 The proposed surface water outfall is to discharge into the SW public surface water beneath Wrotham Road, given no practicable alternatives are nearby.
- 7.9 Surface water flows will be stored in an attenuation tank upstream of a gravity vortex control limited to 5.0l/s. This provides 72% betterment compared to existing 1in1 year brownfield conditions and thereby exceeds the 50% requirement, outlined within the KCC design guidance.
- 7.10 The attenuation tank will be provided with upstream silt traps to mitigate against siltation.
- 7.11 Beyond the 100-year critical storm, exceedance runoff will be directed towards any residual areas of open space and/or car parking, where any above ground storage can be utilised.

- 7.12 Foul flows generated by the proposed development will be served by a new private gravity network, with existing connections to the Southern Water foul sewer to be prioritised for re-use.
- 7.13 All on-site proposed drainage will remain private and will be designed in accordance with Building Regulations Part H and CIRIA C753 and will become the responsibility of the building operator or appointed management company.
- 7.14 As the development will be safe from flooding throughout its lifetime and will actively reduce the flood risk to properties within the downstream catchment, it is recommended that the Local Planning Authority confirm they have no objections to the proposed development.

Appendix A Topographic Survey

Gravesham Borough Council

Appendix B Ground Investigation (Extracts)

Gravesend Borough Council

Generally, all formations should be placed wholly within the same material type, unless specific geotechnical inspection and assessment have been undertaken.

Care should be taken to ensure that any existing services encountered are carefully and satisfactorily blocked to prevent water seeping through the drains and into any excavations.

10. TEMPORARY WORKS

Conventional plant is considered to be suitable for excavation works at the site. However, hydraulic breakers will be required to break up existing reinforced hardstanding and any buried obstructions associated with the existing development.

Shallow excavations may remain stable in the short term but should not be left open for extended periods of time, particularly during inclement weather. Support should be provided, or the sides battered back, in any excavations requiring man entry, in compliance with a suitable risk assessment. Likewise, support is likely to be necessary in deeper excavations.

With regards to a piled foundation solution, it will be necessary to construct a working platform for tracked plant involved in the works. The platform should be designed by a suitably qualified geotechnical specialist in accordance with the guidance given in BRE Document BR470 (2004). The platform can be either designed to be placed on existing ground and then removed following completion of the works, or ground levels can be reduced, and the working platform can be incorporated into the final development.

11. ASSESSMENT OF SOAKAWAY DRAINAGE

The ground conditions comprise clays and silts (including matrix supported Grade Dm structureless chalk strata), which may preclude the use of shallow soakaway drainage. Due to the presence of potential soluble strata beneath the site, ground support conditions relating to the underlying chalk will need to be considered if an infiltration drainage solution is to be proposed and further investigation is recommended to provide additional data in this regard. Based on the available information, it would be prudent to identify an alternative drainage solution at this stage.

12. ROAD PAVEMENTS

Based on the nature of the shallow soils beneath the site a preliminary design equilibrium CBR of 3% may be considered for the design of road pavements. The materials at shallow depth may be regarded as frost susceptible.

13. ASSESSMENT OF MATERIALS FOR WASTE DISPOSAL

It is not known if there is a requirement to remove soils from site and, therefore, development levels should be set such that soils can be retained and reused on site where possible. Providing development levels are set to accommodate soil arisings (for example, from foundation excavations), such materials would not be classified as waste if retained and re-used on site. However, if materials are excess to requirements, they should be taken to an appropriately permitted waste facility.

Appendix C Southern Water Records and Correspondence

Gravesham Borough Council



Head of Planning & Regeneration
Services
Gravesham Borough Council
Civic Centre
Windmill Street
Gravesend
Kent
DA12 1AU

Developer Services
Southern Water
Sparrowgrove House
Sparrowgrove
Otterbourne
Hampshire
SO21 2SW

Tel: 0330 303 0119

Email: developerservices@southernwater.co.uk

Your Ref
20161205
Our Ref
PLAN-016790
Date
19/01/2017

Dear Sirs,

Proposal: The proposed erection of a new four-six storey building with an additional seventh storey penthouse, to provide a total of 99 self-contained flats, comprising 41 x one bedroom flats, 50 x two bedroom flats and 8 x three bedroom flats with 816.5 sq.metres of commercial floorspace at ground floor level; the laying out of 86 parking spaces, 5 motorcycle spaces and 90 cycles spaces in the basement, and 6 additional parking spaces and a delivery bay on the Wrotham Road frontage with an additional 22 street level cycle parking spaces.

Site: Former Police Station, 133 Windmill Street, Gravesend, Kent DA12 1DB.
20161205

Thank you for your letter of 04/01/2017.

Please find attached a plan of the sewer records showing the approximate position of a public sewer within the site. The exact position of the public sewers must be determined on site by the applicant before the layout of the proposed development is finalised.

Please note:

No development or new tree planting should be located within 3 metres either side of the centreline of the public sewer and all existing infrastructure should be protected during the course of construction works.

No new soakaways should be located within 5 metres of a public sewer.

Furthermore, due to changes in legislation that came in to force on 1st October 2011 regarding the future ownership of sewers it is possible that a sewer now deemed to be public could be crossing the above property. Therefore, should any sewer be found during construction works,



an investigation of the sewer will be required to ascertain its condition, the number of properties served, and potential means of access before any further works commence on site.

The applicant is advised to discuss the matter further with Southern Water, Sparrowgrove House Sparrowgrove, Otterbourne, Hampshire SO21 2SW (Tel: 0330 303 0119) or www.southernwater.co.uk.

Our initial investigations indicate that Southern Water can provide foul sewage disposal to service the proposed development. Southern Water requires a formal application for a connection to the public sewer to be made by the applicant or developer.

We request that should this application receive planning approval, the following informative is attached to the consent:

"A formal application for connection to the public sewerage system is required in order to service this development, please contact Southern Water, Sparrowgrove House Sparrowgrove, Otterbourne, Hampshire SO21 2SW (Tel: 0330 303 0119) or www.southernwater.co.uk".

The results of an initial desk top study indicates that Southern Water currently cannot accommodate the needs of this application without the development providing additional local infrastructure. The proposed development would increase flows into the surface water system and as a result increase the risk of flooding in and around the existing area, contrary to paragraph 109 of the National Planning Policy Framework.

Alternatively, the developer can discharge surface water flow no greater than existing levels if proven to be connected and it is ensured that there is no overall increase in flows into the surface water system. You will be required to provide a topographical site survey and/or a CCTV survey showing the existing connection points, pipe sizes, gradients and calculations confirming the proposed surface water flow will be no greater than the existing contributing flows.

Should the Local Planning Authority be minded to approve the application, Southern Water would like the following condition to be attached to any permission. "Development shall not commence until a drainage strategy detailing the proposed means of surface water disposal and a implementation timetable, has been submitted to and approved in writing by, the local planning authority in consultation with the sewerage undertaker. The development shall be carried out in accordance with the approved scheme and timetable."

We suggest the following informative: 'The applicant/developer should enter into a formal agreement with Southern Water to provide the necessary sewerage infrastructure required to service this development. The applicant/developer should contact Southern Water, Sparrowgrove House, Sparrowgrove, Otterbourne, Hampshire SO21 2SW (Tel: 0330 303 0119) or www.southernwater.co.uk' in order to progress the required infrastructure.



It is the responsibility of the developer to make suitable provision for the disposal of surface water. Part H3 of the Building Regulations prioritises the means of surface water disposal in the order

- a Adequate soakaway or infiltration system
- b Water course
- c Where neither of the above is practicable sewer

Southern Water supports this stance and seeks through appropriate Planning Conditions to ensure that appropriate means of surface water disposal are proposed for each development. It is important that discharge to sewer occurs only where this is necessary and where adequate capacity exists to serve the development. When it is proposed to connect to a public sewer the prior approval of Southern Water is required.

The detailed design for the proposed basement should take into account the possibility of the surcharging of the public sewers. We request that should this application receive planning approval, the following informative is attached to the consent:

"Detailed design of the proposed drainage system should take into account the possibility of surcharging within the public sewerage system in order to protect the development from potential flooding.

Please note: water communication pipe in the vicinity of the site.

We request that should this application receive planning approval, the following condition is attached to the consent: "Construction of the development shall not commence until details of the proposed means of foul and surface water sewerage disposal have been submitted to, and approved in writing by, the Local Planning Authority in consultation with Southern Water."

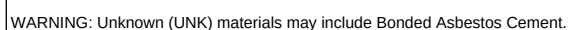
Following initial investigations, Southern Water can provide a water supply to the site. Southern Water requires a formal application for connection and on-site mains to be made by the applicant or developer. We request that should this application receive planning approval, the following informative is attached to the consent:

"A formal application for connection to the water supply is required in order to service this development. Please contact Southern Water, Sparrowgrove House Sparrowgrove, Otterbourne, Hampshire SO21 2SW (Tel: 0330 303 0119) or www.southernwater.co.uk".

Yours sincerely

A handwritten signature in black ink, appearing to read "Luis Silva".

Luis Silva
Developer Services



Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
5618	F	0.00	0.00	
5701	F	22.60	21.27	
5702	F	22.11	20.39	
6602	F	26.05	23.95	
6603	F	0.00	0.00	
6605	F	0.00	0.00	
6607	F	23.60	22.21	
6608	F	23.18	21.03	
6701	F	0.00	0.00	
6702	F	0.00	0.00	
6703	F	0.00	0.00	
6704	F	22.72	19.80	
6705	F	22.24	19.45	
6706	F	22.34	20.26	
6707	F	23.10	21.85	
6708	F	22.57	19.69	
6709	F	0.00	19.30	
6713	F	22.14	22.09	
6801	F	21.38	20.63	
6802	F	21.21	18.30	
6803	F	21.05	18.10	
6804	F	0.00	0.00	
6805	F	20.84	0.00	
6806	F	20.94	17.83	
6807	F	0.00	0.00	
6808	F	20.39	0.00	
6905	F	20.18	0.00	
6906	F	19.94	8.27	
7701	F	24.51	0.00	
7702	F	24.01	21.27	
7703	F	23.44	0.00	
7704	F	22.23	20.89	
7705	F	22.44	19.16	
7706	F	0.00	0.00	
7707	F	0.00	0.00	
7708	F	25.24	0.00	
7709	F	23.21	0.00	
7710	F	22.63	20.04	
7711	F	24.25	21.19	
7712	F	0.00	0.00	
7801	F	21.16	18.43	
7802	F	20.89	0.00	
7803	F	20.77	0.00	
7804	F	21.38	0.00	
7805	F	20.75	0.00	
7806	F	20.46	17.85	
7807	F	20.32	17.93	
7808	F	20.46	16.93	

[illegible]

Appendix D Greenfield Runoff Rates

Gravesham Borough Council

AWP		Page 1
Kensington Court Pynes Hill EX2 5TY		
Date 23/02/2022 11:52 File 1305-SW-101-cellular st...	Designed by Verity.Saunders Checked by	
XP Solutions Source Control 2018.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.370
Area (ha)	0.362	Urban	0.000
SAAR (mm)	560	Region Number	Region 7

Results 1/s

QBAR Rural	0.8
QBAR Urban	0.8
Q2 years	0.7
Q1 year	0.7
Q30 years	1.8
Q100 years	2.6

©1982-2018 Innovyze

Appendix E Proposed Site Plan

Gravesham Borough Council

REVISIONS

Rev.	Date	By
P01	25-02-2022	JS
P02	25-03-2022	JS

APARTMENTS	
1 bed	48
2 bed	27
TOTAL	75
(36% - 2 Bed)	

Key

- 1 bed
- 2 bed
- Communal areas

- Site boundary
- Line of existing wall
- Existing trees to be pruned back and crowns lifted (not in ownership)
- Existing tree canopies



Churchill
Retirement Living

Churchill House * 6 Chertsey Road
Byfleet * Surrey KT14 7AG
www.churchillretirement.co.uk

Telephone: (01932) 338700 Fax: (01932) 338701

planningissues
TOWN PLANNING AND ARCHITECTURE

Churchill House * Christchurch Road
Parkside * Ringwood
Hampshire * BH24 3SG

Telephone: (01425) 462372 Fax: (01425) 462101

Project Title
**PROPOSED RETIREMENT LIVING APARTMENTS
FORMER POLICE STATION,
WINDMILL STREET, GRAVESEND
DA12 1DB**

Drawing Title

**SITE PLAN
PLANNING**

Scale	1: 200 @ A1	Date	MARCH 22
Drawn	JS	Checked	BS
Drawing No.	20085GD_PL_001	Rev.	P0.2

PLOT DATE: 29 March 2022



Proposed Retirement Living Apartments at 133 Windmill St, Gravesend DA12 1DB

Appendix F MicroDrainage Calculations

Gravesham Borough Council

Awcock Ward Partnership Consulting Ltd		Page 1
Kensington Court Woodwater Park Pynes Hill Exeter EX2 5TY	1305 - Windmill St, Gravesend CELLULAR TANK RevB lin100yr+40%CC	
Date 12/04/2022 16:30	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions		Source Control 2018.1

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 153 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	98.264	0.264	0.0	5.0	5.0	48.8	O K
30 min Summer	98.336	0.336	0.0	5.0	5.0	62.3	O K
60 min Summer	98.399	0.399	0.0	5.0	5.0	73.9	O K
120 min Summer	98.429	0.429	0.0	5.0	5.0	79.5	O K
180 min Summer	98.428	0.428	0.0	5.0	5.0	79.2	O K
240 min Summer	98.419	0.419	0.0	5.0	5.0	77.7	O K
360 min Summer	98.397	0.397	0.0	5.0	5.0	73.5	O K
480 min Summer	98.370	0.370	0.0	5.0	5.0	68.6	O K
600 min Summer	98.341	0.341	0.0	5.0	5.0	63.2	O K
720 min Summer	98.314	0.314	0.0	5.0	5.0	58.1	O K
960 min Summer	98.264	0.264	0.0	5.0	5.0	48.9	O K
1440 min Summer	98.187	0.187	0.0	5.0	5.0	34.7	O K
2160 min Summer	98.127	0.127	0.0	4.9	4.9	23.5	O K
2880 min Summer	98.106	0.106	0.0	4.2	4.2	19.5	O K
4320 min Summer	98.085	0.085	0.0	3.1	3.1	15.7	O K
5760 min Summer	98.073	0.073	0.0	2.5	2.5	13.6	O K
7200 min Summer	98.066	0.066	0.0	2.1	2.1	12.2	O K
8640 min Summer	98.061	0.061	0.0	1.9	1.9	11.2	O K
10080 min Summer	98.056	0.056	0.0	1.6	1.6	10.4	O K
15 min Winter	98.297	0.297	0.0	5.0	5.0	55.0	O K
30 min Winter	98.381	0.381	0.0	5.0	5.0	70.5	O K
60 min Winter	98.451	0.451	0.0	5.0	5.0	83.5	O K
120 min Winter	98.490	0.490	0.0	5.0	5.0	90.7	O K
180 min Winter	98.487	0.487	0.0	5.0	5.0	90.1	O K
240 min Winter	98.474	0.474	0.0	5.0	5.0	87.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	51.4	18
30 min Summer	90.705	0.0	67.6	33
60 min Summer	56.713	0.0	85.1	62
120 min Summer	34.246	0.0	102.9	120
180 min Summer	25.149	0.0	113.4	148
240 min Summer	20.078	0.0	120.7	180
360 min Summer	14.585	0.0	131.5	248
480 min Summer	11.622	0.0	139.8	316
600 min Summer	9.738	0.0	146.4	382
720 min Summer	8.424	0.0	152.0	446
960 min Summer	6.697	0.0	161.1	570
1440 min Summer	4.839	0.0	174.5	806
2160 min Summer	3.490	0.0	189.2	1128
2880 min Summer	2.766	0.0	199.8	1476
4320 min Summer	1.989	0.0	215.4	2204
5760 min Summer	1.573	0.0	227.5	2936
7200 min Summer	1.311	0.0	236.9	3672
8640 min Summer	1.129	0.0	244.7	4400
10080 min Summer	0.994	0.0	251.3	5136
15 min Winter	138.153	0.0	57.6	18
30 min Winter	90.705	0.0	75.8	32
60 min Winter	56.713	0.0	95.4	60
120 min Winter	34.246	0.0	115.3	116
180 min Winter	25.149	0.0	127.0	168
240 min Winter	20.078	0.0	135.2	190

Awcock Ward Partnership Consulting Ltd		Page 2
Kensington Court Woodwater Park Pynes Hill Exeter EX2 5TY	1305 - Windmill St, Gravesend CELLULAR TANK RevB lin100yr+40%CC	
Date 12/04/2022 16:30	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions		Source Control 2018.1

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
360 min Winter	98.443	0.443	0.0	5.0	5.0	82.1	O K
480 min Winter	98.406	0.406	0.0	5.0	5.0	75.2	O K
600 min Winter	98.364	0.364	0.0	5.0	5.0	67.3	O K
720 min Winter	98.319	0.319	0.0	5.0	5.0	59.1	O K
960 min Winter	98.243	0.243	0.0	5.0	5.0	45.0	O K
1440 min Winter	98.143	0.143	0.0	5.0	5.0	26.5	O K
2160 min Winter	98.102	0.102	0.0	4.0	4.0	18.9	O K
2880 min Winter	98.086	0.086	0.0	3.2	3.2	15.9	O K
4320 min Winter	98.070	0.070	0.0	2.3	2.3	13.0	O K
5760 min Winter	98.061	0.061	0.0	1.9	1.9	11.3	O K
7200 min Winter	98.055	0.055	0.0	1.5	1.5	10.2	O K
8640 min Winter	98.051	0.051	0.0	1.4	1.4	9.4	O K
10080 min Winter	98.047	0.047	0.0	1.2	1.2	8.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	14.585	0.0	147.4	268
480 min Winter	11.622	0.0	156.6	344
600 min Winter	9.738	0.0	164.0	418
720 min Winter	8.424	0.0	170.3	482
960 min Winter	6.697	0.0	180.5	604
1440 min Winter	4.839	0.0	195.5	810
2160 min Winter	3.490	0.0	211.9	1128
2880 min Winter	2.766	0.0	223.8	1496
4320 min Winter	1.989	0.0	241.3	2208
5760 min Winter	1.573	0.0	254.8	2944
7200 min Winter	1.311	0.0	265.3	3672
8640 min Winter	1.129	0.0	274.1	4392
10080 min Winter	0.994	0.0	281.5	5104

Awcock Ward Partnership Consulting Ltd		Page 3
Kensington Court	1305 - Windmill St, Gravesend	
Woodwater Park Pynes Hill	CELLULAR TANK RevB	
Exeter EX2 5TY	lin100yr+40%CC	
Date 12/04/2022 16:30	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.201

Time (mins)	Area
From:	To: (ha)

0	4 0.201
---	---------

Awcock Ward Partnership Consulting Ltd		Page 4
Kensington Court	1305 - Windmill St, Gravesend	
Woodwater Park Pynes Hill	CELLULAR TANK RevB	
Exeter EX2 5TY	lin100yr+40%CC	
Date 12/04/2022 16:30	Designed by JB	
File 1305-SW-101-CELLULAR STRORAGE ...	Checked by CPY	
XP Solutions	Source Control 2018.1	

Model Details

Storage is Online Cover Level (m) 100.000

Cellular Storage Structure

Invert Level (m) 98.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	195.0	0.0	0.500	195.0	0.0	0.501	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0113-5000-0500-5000
Design Head (m) 0.500
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 113
Invert Level (m) 98.000
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

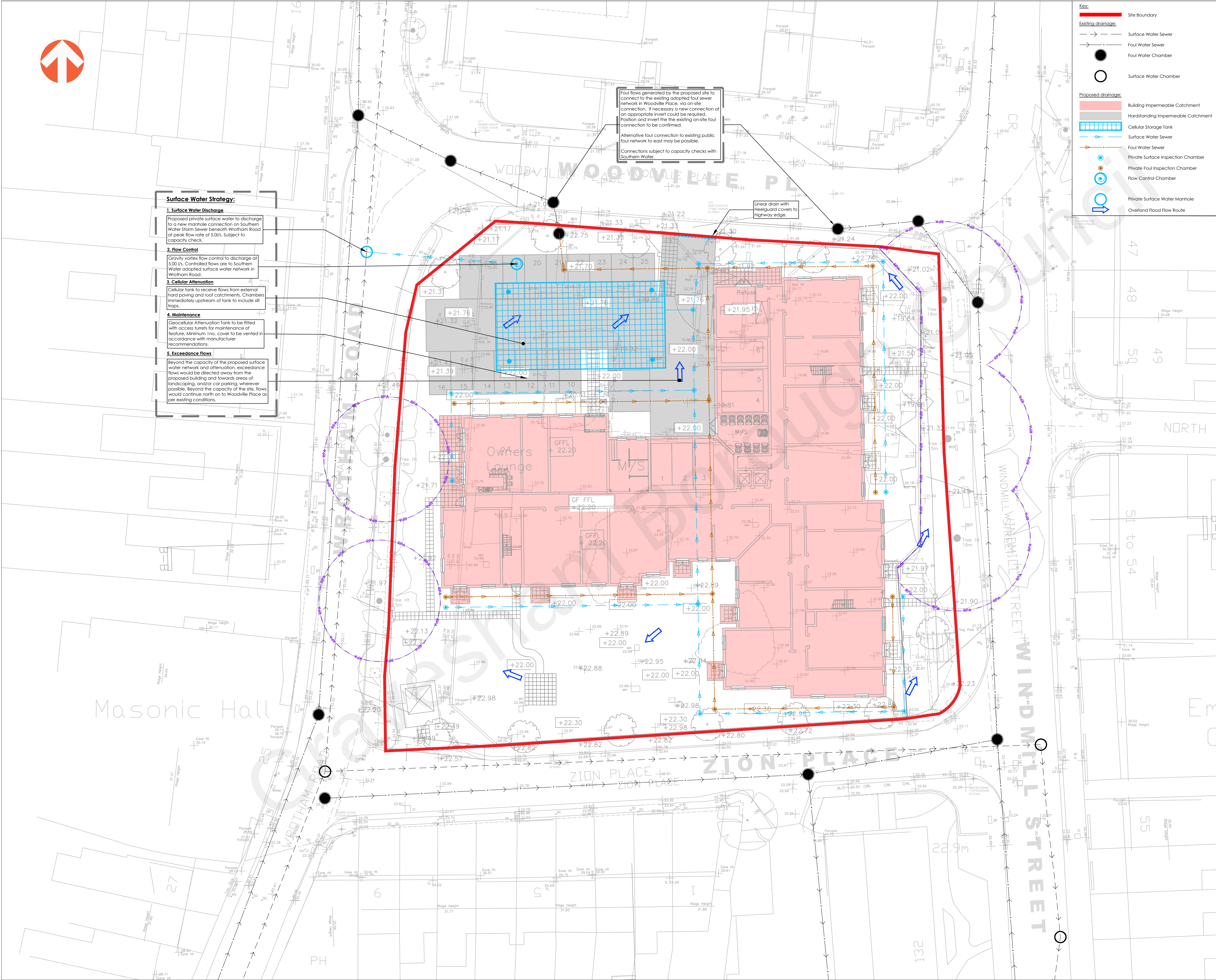
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	5.0	Kick-Flo®	0.372	4.4
Flush-Flo™	0.179	5.0	Mean Flow over Head Range	-	4.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	0.800	6.2	2.000	9.6	4.000	13.3	7.000	17.4
0.200	5.0	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.1
0.300	4.8	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.7
0.400	4.5	1.400	8.1	2.600	10.8	5.500	15.4	8.500	19.2
0.500	5.0	1.600	8.6	3.000	11.6	6.000	16.1	9.000	19.8
0.600	5.4	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.3

Appendix G Preliminary Drainage Layout

Gravesham Borough Council



Key:

Existing drainage:

- Surface Water Sewer
- Foul Water Sewer
- Foul Water Chamber
- Surface Water Chamber

Proposed drainage:

- Building Impermeable Catchment
- Hardstanding Impermeable Catchment
- Surface Water Sewer
- Foul Water Sewer
- Private Surface Inspection Chamber
- Private Foul Inspection Chamber
- Flow Control Chamber
- Private Surface Water Manhole
- Overland Flood Flow Route

Surface Water Strategy:

1. Surface Water Discharge
Proposed private surface water to discharge to a new manhole connection on Southern Water Storm Sewer beneath Wrotham Road at peak flow rate of 5.0 l/s. Subject to capacity check.

2. Flow Control
Gravity vortex flow control to discharge at 5.00 l/s. Controlled flows are to Southern Water adapted surface water network in Wrotham Road.

3. Cellular Attenuation
Cellular tank to receive flows from external hard paving and roof catchments. Chambers immediately upstream of tank to include silt traps.

4. Maintenance
Geocellular Attenuation Tank to be fitted with access tunnels for maintenance of feature. Minimum 1m cover to be vented in accordance with manufacturer recommendations.

5. Exceedance Flows
Beyond the capacity of the proposed surface water network and attenuation, exceedance flows would be directed away from the proposed building and towards areas of landscaping, and/or car parking, wherever possible. Beyond the capacity of the site, flows would continue north on to Woodville Place as per existing conditions.

Foul flows generated by the proposed site to connect to the existing adopted foul sewer network in Woodville Place, via on-site connection. If necessary a new connection at an appropriate invert could be required. Position and invert the existing on-site foul connection to be confirmed.

Alternative foul connection to existing public foul network to east may be possible.

Connections subject to capacity checks with Southern Water.

Area Summary Schedule

Net Developable Area	0.362 ha
Impermeable Catchment	0.201 ha

Pre-Development Runoff

The greenfield runoff rates have been assessed for the 'net developable area' using the CP-SuDS Method. The calculation excludes large areas of open space which will remain undeveloped.

The brownfield runoff rates have been assessed, using the Modified Rational Method, for a contributing area (0.283ha) that is considered likely to discharge to the existing drainage network on site.

Return Period	Greenfield Rate	Brownfield Rate
1yr	0.7 l/s	33.7 l/s
30yr	1.8 l/s	95.1 l/s
100yr	2.4 l/s	126.5 l/s

Attenuation Summary

Cellular Storage Tank	0.201 ha
Hydraulic Control	Hydraulic limited to 5.0 l/s @ 0.5m head
Ref: MD-SHE-0113-5000-0500-5000	
Porosity	95%
Dimension	Tank 19.5m X 10.0m X 0.5m deep

Total 100yr+40% Volume 90.7m³

Total 100yr+40%CC Discharge: 5.0 l/s

Notes:

- The proposed development has been assessed in line with the National Planning Policy Framework, to allow the planning application to be progressed and to show that the development can be undertaken in an acceptable manner from a flood risk perspective.
- The proposed development is located within Flood Zone 1 and is not known to be susceptible to flooding from pluvial, groundwater, infrastructure or artificial sources.
- To ensure the development is safe throughout its lifetime, the surface water strategy accounts for runoff in up to the 1 in 100 year return period.
- The strategy also safeguards against climate change (40%), providing betterment over existing conditions, where the rate and volume of runoff would continue to increase due to climate change.
- The existing ground conditions may be susceptible to solution features and therefore advice indicates drainage strategies should consider discharges other than by infiltration.
- Storm water runoff will be attenuated on-site and will discharge via a new connection to the existing Southern Water surface water sewer beneath Wrotham Road.
- The impermeable drained catchment is not being increased by the development, meaning Long Term Storage is not required.
- The proposed surface water outfall is to discharge into the SW public surface water beneath Wrotham Road, given no practicable alternatives are nearby.
- Surface water flows will be stored in an attenuation tank upstream of a gravity vortex control limited to 5.0 l/s. This provides 72% betterment compared to existing 1m³ year brownfield conditions and thereby exceeds the 50% requirement, outlined within the KCC design guidance.
- The attenuation tank will be provided with upstream silt traps to mitigate against siltation.
- Beyond the 100-year critical storm, exceedance runoff will be directed towards any residual areas of open space and/or car parking, where any above ground storage can be utilised.
- Foul flows generated by the proposed development will be served by a new private gravity network, with existing connections to the Southern Water foul sewer to be prioritised for re-use.
- All on-site proposed drainage will remain private and will be designed in accordance with Building Regulations Part H and CIRIA C753 and will become the responsibility of the building operator or appointed management company.
- As the development will be safe from flooding throughout its lifetime and will actively reduce the flood risk to properties within the downstream catchment, it is recommended that the Local Planning Authority confirm they have no objections to the proposed development.

B	12.04.2022	UPDATED TO SUIT CLIENTS LATEST LAYOUT	RF	JB	CPY
A	15.03.2022	INITIAL ISSUE	VS	JB	CPY
REV	DATE	DESCRIPTION	BY	CHK	APD

DRAWING STATUS: PLANNING APPLICATION

CLIENT: CHURCHILL RETIREMENT LIVING

PROJECT: WINDMILL STREET, GRAVESEND

TITLE: PRELIMINARY DRAINAGE LAYOUT

PROJECT No:	DRAWING No:	REV:
1305	01-PDL-1001	B

SCALE @ A1: 0 1:200 10 metres

DESIGN BY: awcockward partnership

Awcock Ward Partnership, Adda House, Pynes Hill, Exeter, EX2 5TU
Tel: 01392 409007 Web: www.awpexeter.com