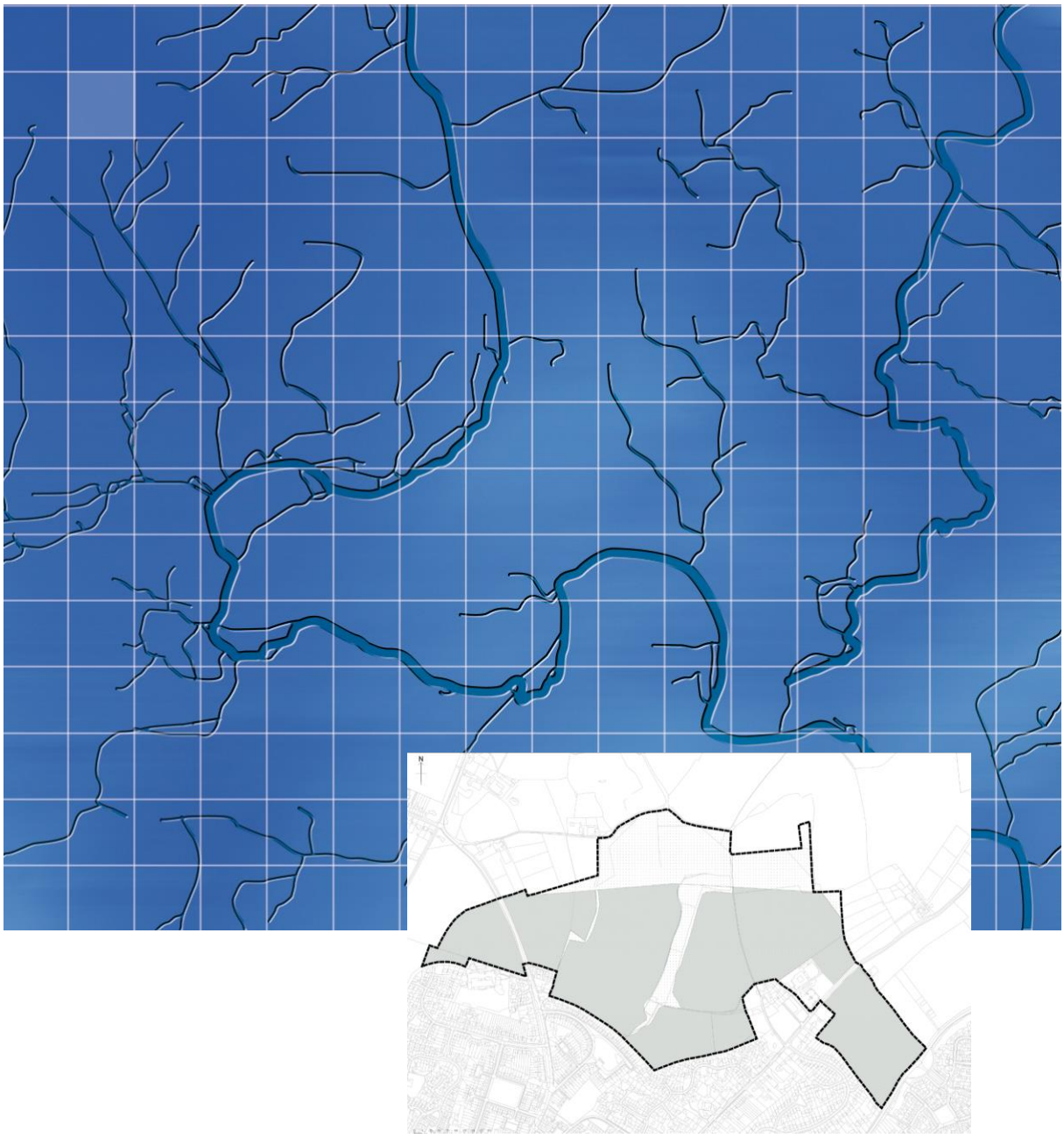
West Oxfordshire District Council

October 2016

Witney Level 2 Strategic Flood Risk Assessment Addendum



Wallingford HydroSolutions Limited

West Oxfordshire District Council

Witney Level 2 Strategic Flood Risk Assessment Addendum

Document issue details

WHS1468 Version 1.2

For and on behalf of Wallingford HydroSolutions Ltd.

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Approved by	Paul Blackman
Position	*Technical Director*
Date	October 2016

This report has been produced in accordance with the WHS Quality Management system which is certified as meeting the requirements of ISO 9001:2008 and ISO 14001:2004

Contents

1 Background

Following completion of the Witney Level 2 SFRA report in March 2015, the developable area for the Strategic Development Area (SDA) has increased, along with the housing density to provide a total of 1400 housing units, increasing from the previously proposed 1000 units.

West Oxfordshire District Council (WODC) requires an update to the report to reflect the changes to the proposed SDA. Potential points of discharge from new areas are reviewed, and the implications of increased housing density on SUDS measures assessed.

Attenuation storage requirements are updated in view of the proposed changes, and new climate change guidance released since the previous report.

2 General Arrangement

WODC initially proposed that a residential development comprising 1000 dwellings be spread across an area of greenfield land north of Witney. WODC are now proposing that a further 400 dwellings be built at the site.

To accommodate the additional dwellings, it is proposed that a 4.0 hectare plot on land west of Hailey Road be integrated into the SDA. The developable area of the main part of the site will also be expanded, and the density of the development increased to 35 dwellings per hectare across the whole site. Figure 1 shows the updated SDA.

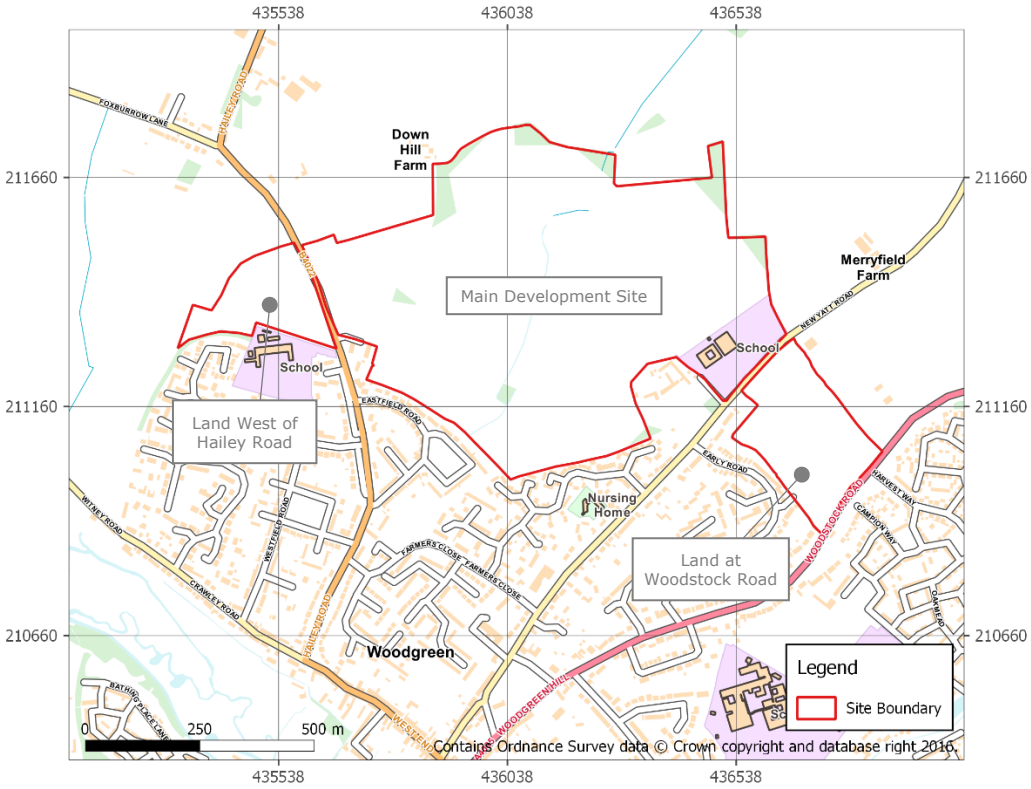


Figure 1- Proposed Strategic Development Area

3 Land West of Hailey Road

3.1 Site Location

It is proposed that the development site be extended to encompass land immediately west of the Hailey Road (NGR: 435540, 211385). The site is bounded to the south by existing residential developments and the Witney Community Primary School, whilst the Hailey Road forms the eastern boundary of the site.

3.2 Topography

The topography of the land west of Hailey Road has been analysed using LiDAR data. The site has a moderate gradient with ground levels ranging between 93.56m AOD and 99.80m AOD. The majority of the land slopes to the south east towards Hailey Road, with overland flow likely routing from higher ground to the north west. This is with the exception of land to the far west which borders the existing residential area to the south. Here the topography slopes in a south westerly direction.

GIS software was used to map the flow directions based on the topographic data, Figure 2 shows these along with the associated LiDAR levels.

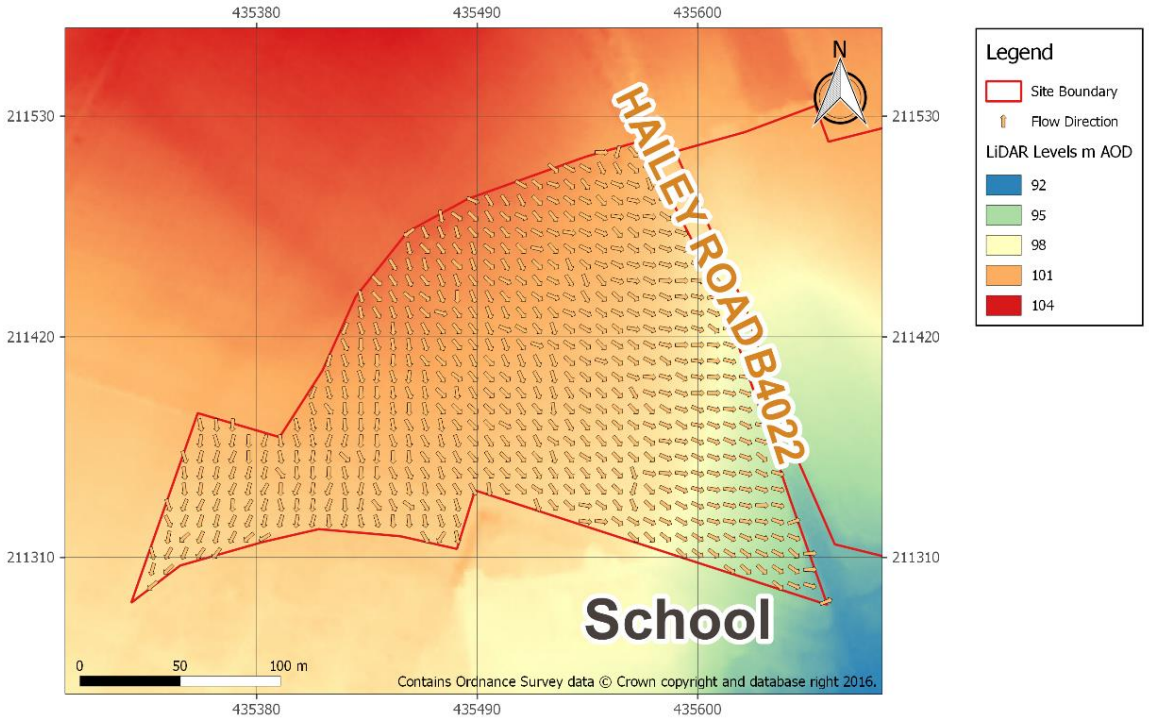


Figure 2- Site Topography

3.3 Flood Risk

3.3.1 Fluvial Flooding

To assess the risk of fluvial flooding for the additional parcel of land, Environment Agency (EA) flood maps have been reviewed. The flood maps only include the flood risk associated with Main Rivers. The site is entirely within Flood Zone 1, which is land assessed as having a less than 1 in 1,000 annual probability of river flooding. The risk of fluvial flooding is therefore considered low.

3.3.2 Surface Water

The risk of surface water flooding has been assessed by reviewing the surface water flood maps published by the EA.

The EA flood maps show that there is a very low risk of surface water flooding. The site is not predicted to flood during flood events up to and including the 1 in 1000 year flood event. The extent of surface water flooding appears to be constrained by the topography of the site, with surface water flooding along some of the roads downslope of the site.

3.3.3 Groundwater Flooding

Review of the relevant BGS reports indicates that the area west of the Hailey road could have a relatively high water table, at a depth likely to be less than 3m below ground level. Mapping data indicate the presence of springs on the northwest periphery of the main development site, adjacent to Downhill Farm.

Anecdotal observations of Oxfordshire County Council indicate that surface water flooding has occurred on Hailey Road upslope of the Witney Primary School and that this flooding may have been the result of groundwater seepage from the site. However, there are no records available to verify this.

The land west of Hailey Road is underlain by a combination of permeable limestone and impermeable mudstone. The Forest Marble Formation (FMB) is prominent within this site alternating between seams of limestone which form the Cornbrash Formation (CB-LMST). The permeability of the underlying ground is therefore expected to be spatially variable.

It is considered that there is a moderate risk of groundwater flooding, which can be managed by appropriate design of the developed site levels. Given the relatively complex geology and in order to better inform future design it is recommended that ground water monitoring is undertaken to establish likely maximum groundwater levels, seasonal variation and the presence of ephemeral springs.

3.4 Existing Sewers

An asset location search and pre-developer's enquiry has been submitted to Thames Water for the proposed residential development. The search revealed there to be no existing surface water sewer connections at or close to the development site. A response to the pre-developer's enquiry is pending.

Thames Water have however confirmed that there are foul sewers running along the Hailey Road adjacent to the site, and in Schofield Avenue serving the residential area to the west of the school.

In terms of foul drainage the most feasible solution is likely to be two gravity sewers, one draining the eastern portion of the site, connecting to the sewer running along the Hailey Road at Manhole 6205. The other draining the eastern portion of the site, connecting to the sewer running along Schofield Avenue at manhole 3301.

A formal Section 106 connection approval should be prepared and submitted at detailed design stage. The asset location search map is provided in Appendix B.

3.5 Highway Drainage

Oxfordshire County Council (OCC) has confirmed that there is a highway drain running along the Hailey Road. The highway drain starts on the other side of the road from the school and discharges into the main culvert running down the Hailey Road.

According to the council the springs in the local area regularly discharge onto the highway running down the road towards the school and the highway drainage system.

The design of any future development should include adequate ground investigation and ensure adequate control of any groundwater discharge from the site. There is the potential to alleviate any existing groundwater flooding problems through appropriate design.

3.6 Surface Water Drainage Options

Our review of available data suggests that the land west of Hailey Road is a mixture of permeable and impermeable geology, with parts of the site that may be suitable for infiltration systems.

However the sloping topography, high water table at the site, and the presence of springs nearby, may make the use of significant infiltration techniques harder to achieve. It is recommended that a geotechnical investigation be undertaken to obtain further information relating to soil permeability and soil infiltration rates. This will determine whether infiltration could be viable throughout the site or whether more conventional solutions will be required.

If infiltration SuDS should prove not to be viable, it may be necessary to drain to an existing watercourse or public sewer. The topography of the site makes drainage to one outfall difficult, given that the far western portion of the site drains directly south towards the existing residential area.

Suitable outfall locations are also limited. Based on aerial photography there appears to be no existing drainage ditches near the site. The closest watercourse, is a small stream running alongside Milking Lane approximately 300m west of the site. During extreme events the site could potentially be drained via an exceedance route to this watercourse, however this option is likely to be subject to landowner constraints, and require significant works.

Drainage to the east and south is inhibited by existing development, and pressures on the Hailey road land drain. Any discharge to the highway drain would need to be heavily attenuated, and may still prove unsuitable. A new surface water sewer connection could be established, this would either need to be of substantial length in order to connect to the existing surface water sewer network, or connect to a new network introduced to the east of Hailey Road for the rest of the North Witney SDA.

4 Attenuation Requirements

4.1 Climate Change

Since the completion of the original report in 2015, the EA has published new guidelines on climate change. In terms of rainfall levels whereas before a blanket figure of 30% was applied to the potential change in a 100 year design life, now two allowances, a central estimate of 20% and an upper estimate of 40% exist. These seek to represent the uncertainty in climate projections.

The new guidance from the EA, applies the same risk based approach to peak river flows with the addition of a 'higher central' allowance. In the case of river flows the allowances are divided into eleven major river basins for England. For North Witney, climate projections for the Thames region are applied, these are shown in Table 1.

Table 1- Peak River Flow Allowances for the Thames River Basin District

Allowance Category	Total potential change anticipated 2015-2039	Total potential change anticipated 2040-2069	Total potential change anticipated 2070-2115
Upper End	25%	35%	70%
Higher Central	15%	25%	35%
Central	10%	15%	25%

4.2 Proposed Land Use

For the previous SFRA it was assumed that 40% of the site will contain impermeable surfaces. This was a conservative assumption based on typical development layouts, where the impermeable surface areas for housing developments is generally in the range of 30% to 40%.

The conservative nature of this assumption means that despite an increase in housing density, it is unlikely that the proposed layout will have an impermeable area greater than 40%. The figure of 40% is therefore retained.

The development area is now 59.5 ha with the addition of land west of Hailey Road. Assuming that 40% of the development area will be impermeable, the total impermeable area is 23.8ha. This impermeable area is used to undertake a preliminary assessment of the likely attenuation requirements for this development.

4.3 SuDS Requirements

As in the previous SFRA. the drainage strategy for the development should seek to achieve betterment on greenfield run-off rates, in order to alleviate existing flooding problems associated with the Hailey Road drain.

Attenuation storage volumes have been calculated for the site on the basis that an average current greenfield runoff rate is maintained for all rainfall events up to and including the 1 in 100 year plus an allowance of 40% for climate change. The allowance for climate change is updated to reflect the latest guidance, and represents the upper end peak rainfall intensity.

Due to the close proximity to the two other parcels of land, the site west of Hailey road is assumed to have the same site characteristics, and the greenfield runoff rates calculated in the original report are adopted. For the land west of Hailey Road a conservative estimate of storage requirement per unit area has been calculated as 368.5 m3/ha. The total storage requirement across the site with the addition of the land west of Hailey road, and the 40% climate change allowance is also 368.5 m3/ha, an increase from the 334.0 m3/ha estimated in the previous report. Associated calculations are provided in Appendix A.

Usually storage features are designed to be between 0.5m and 1.5m deep, depending on the site topography and location of the storage feature, which can only be established during detailed design. Based on the updated storage requirement of 368.5 m3/ha and a storage depth of between 0.5m and 1.5m, the required land area for drainage features at the site is between 245.7 m2/ha and 737.1 m2/ha. This equates to an indicative land take of between 2.5% and 7.4% over the total site area of 59.5 ha (a modest increase over the original estimate of 2.2% - 6.7%). A detailed ground investigation is required to determine the storage requirements more accurately.

In view of increases in both storage requirements and housing density, careful consideration should be given to the siting of different SuDS features. The increased density of housing will provide an additional constraint on the selection of appropriate above ground SUDS features. A mix of source control and end of pipe attenuation features should be utilised and where space is limited below ground SuDS features may be required, which have higher maintenance costs.

Therefore where possible the housing layout and landscaping should be adapted to allow for enough space to accommodate SUDS drainage features, and provide suitable falls. Currently around 9.5ha of open space is proposed in the north of the site, which is at the upslope limit. Consideration should be given to dispersing the open space through the development to facilitate the provision of SUDS drainage features.

5 Conclusions and Recommendations

The conclusions and recommendations from this SFRA Addendum are outlined below:

- Following completion of the Witney Level 2 SFRA report in March 2015, the developable area for the Strategic Development Area (SDA) has increased, along with the housing density to provide a total of 1400 housing units, increasing from the previously proposed 1000 units. The main area of expansion is on land west of the Hailey Road.

5.1 Land to the west of Hailey Road

- The proposed development site to the West of Hailey Road lies within Flood Zone 1, which is considered to be at little or no risk to fluvial flooding. Therefore, the risk of flooding from fluvial sources is considered to be negligible.
- The Land west of Hailey Road is considered to be at low risk of surface water flooding, with no flooding identified on the EA's surface water flood maps.
- It is concluded that the site is at moderate risk from groundwater flooding due to a high water table at the proposed development site. This should be managed by appropriate design of the developed site levels and drainage features to adequately control groundwater.
- An asset location search and pre-developer's enquiry has been submitted to Thames Water for the proposed residential development. Thames Water has confirmed that there are foul sewers running along the Hailey Road adjacent to the site, and in Schofield Avenue serving the residential area to the west of the school.
- We await a response to the pre-developer's enquiry which will confirm if the Foul Sewer network has capacity to convey foul water from the Land west of Hailey Road.
- The asset search revealed there to be no existing surface water sewer connections at or close to the development site to the west of Hailey Road. The nearest watercourse is 300m to the south west.
- Oxfordshire County Council (OCC) has confirmed that whilst there is a highway drain running along the Hailey Road, there are concerns about any further drainage leading to the Hailey land drain.
- Infiltration drainage may not be viable, but this should be confirmed through ground investigation. Given the apparent lack of suitable surface water drainage discharge points, it is possible that a separate long outfall may be required to drain the site.

5.2 SuDS Requirements

- The total storage requirement across the site with the addition of the land west of Hailey road, and the 40% climate change allowance is 368.5 m^3/ha, an increase on 334.0 m^3/ha estimated in the previous report. This equates to a land take of between 2.5% and 7.4% over the total site area, a modest increase over the original estimate of between 2.2% and 6.7%. These figures should be reviewed and updated during detailed design.
- Given the proposed increase in housing density, the housing layout and landscaping should be adapted to allow for enough space to accommodate SUDS drainage features, and provide suitable falls. Currently around 9.5ha of open space is proposed in the north of the site, which is at the upslope limit. Consideration should be given to dispersing the open space through the development to facilitate the provision of SUDS drainage features.

Appendix 1 Surface Water Runoff Calculations

Storage Estimate
Calculation Sheet

Site Name	Main Development Site
Site Location	Witney
X (Eastings)	436133
Y (Nothings)	211398
Engineer	Daniel Hamilton
Checked by	Brett Park
Reference	WHS 1468
Revision	1
Date	Oct-16

Interception Storage

Total Area (m^2) [A] 488,000
Impermeable Area (m^2), 40% assumed [B] = [A] x 40% 195,200

Interception storage prevents runoff up to a depth of 5mm

Volume required for Inception Storage [C] = [B] x 0.005 976 V_{Incp} = **976** m^3

Attenuation Storage

Outflow rates from Greenfield Runoff estimate
Average Outflow used to provide a conservative estimate (Min: 2 l/s/ha)

Event	*Q (l/s/ha)*
Q1	*1.3*
Q100	*4.7*
Avg. Outflow	*3.0*

From FEH CD Rom

Rainfall Duration (mins/hrs)	Rainfall Depth (mm)	Rainfall + CC (40%) (mm)	Inflow vol (less Incp.) (m3/m2)	Outflow (m3/s) x (m3/m2)	Volume = In - Out (m3/m2)
15 min	30.3	42.4	0.037	0.0003	0.037
30 min	35.5	49.7	0.045	0.0005	0.044
1 hr	41.7	58.4	0.053	0.0011	0.052
2 hr	48.9	68.5	0.063	0.0022	0.061
4 hr	57.3	80.2	0.075	0.0043	0.071
6 hr	63.0	88.2	0.083	0.0065	0.077
12 hr	73.8	103.3	0.098	0.0129	0.085
24 hr	84.3	118.0	0.113	0.0259	0.087
48 hr	96.2	134.7	0.130	0.0518	0.078

MAX Storage Required (m^3/m^2) [D] 0.087

Est. Attenuation Storage (m^3) [E] = [B] x [D] 17,010 V_{Attn} = **17,010** m^3

Total Storage Required

Total Storage = Inception Storage + Attenuation Storage

[F] = [C] + [E] 17,986 V_{Tot} = **17,986** m^3

Storage Estimate
Calculation Sheet

Site Name	Land at Woodstock Road
Site Location	Witney
X (Eastings)	436693
Y (Nothings)	211099
Engineer	Daniel Hamilton
Checked by	Brett Park
Reference	WHS 1468
Revision	1
Date	Oct-16

Interception Storage

Total Area (m^2)	[A]	67,000	
Impermeable Area (m^2), 40% assumed	[B] = [A] x 40%	26,800	
Interception storage prevents runoff up to a depth of 5mm			
Volume required for Inception Storage	[C] = [B] x 0.005	134	V_{Incp} = **134** m^3

Attenuation Storage

Outflow rates from Greenfield Runoff estimate
Average Outflow used to provide a conservative estimate (Min: 2 l/s/ha)

Event	*Q (l/s/ha)*
Q1	*1.3*
Q100	*4.7*
Avg. Outflow	*3.0*

From FEH CD Rom

Rainfall Duration (mins/hrs)	Rainfall Depth (mm)	Rainfall + CC (40%) (mm)	Inflow vol (less Incp.) (m3/m2)	Outflow (m3/s) x (m3/m2)	Volume = In - Out (m3/m2)
15 min	30.3	42.4	0.037	0.0003	0.037
30 min	35.5	49.7	0.045	0.0005	0.044
1 hr	41.7	58.4	0.053	0.0011	0.052
2 hr	48.9	68.5	0.063	0.0022	0.061
4 hr	57.3	80.2	0.075	0.0043	0.071
6 hr	63.0	88.2	0.083	0.0065	0.077
12 hr	73.8	103.3	0.098	0.0129	0.085
24 hr	84.3	118.0	0.113	0.0259	0.087
48 hr	96.2	134.7	0.130	0.0518	0.078

MAX Storage Required (m^3/m^2)	[D]	0.087	
Est. Attenuation Storage (m^3)	[E] = [B] x [D]	2,335	V_{Attn} = **2,335** m^3

Total Storage Required

Total Storage = Inception Storage + Attenuation Storage

	[F] = [C] + [E]	2,469	V_{Tot} = **2,469** m^3

Storage Estimate
Calculation Sheet

Site Name	Land West of Hailey Road
Site Location	Witney
X (Eastings)	435520
Y (Nothings)	211409
Engineer	Daniel Hamilton
Checked by	Brett Park
Reference	WHS 1468
Revision	1
Date	Oct-16

Interception Storage

Total Area (m^2)	[A]	40,000	
Impermeable Area (m^2), 40% assumed	[B] = [A] x 40%	16,000	
Interception storage prevents runoff up to a depth of 5mm			
Volume required for Inception Storage	[C] = [B] x 0.005	80	V_{Incp} = **80** m^3

Attenuation Storage

Outflow rates from Greenfield Runoff estimate
Average Outflow used to provide a conservative estimate (Min: 2 l/s/ha)

Event	*Q (l/s/ha)*
Q1	*1.3*
Q100	*4.7*
Avg. Outflow	*3.0*

From FEH CD Rom

Rainfall Duration (mins/hrs)	Rainfall Depth (mm)	Rainfall + CC (40%) (mm)	Inflow vol (less Incp.) (m3/m2)	Outflow (m3/s) x (m3/m2)	Volume = In - Out (m3/m2)
15 min	30.3	42.4	0.037	0.0003	0.037
30 min	35.5	49.7	0.045	0.0005	0.044
1 hr	41.7	58.4	0.053	0.0011	0.052
2 hr	48.9	68.5	0.063	0.0022	0.061
4 hr	57.3	80.2	0.075	0.0043	0.071
6 hr	63.0	88.2	0.083	0.0065	0.077
12 hr	73.8	103.3	0.098	0.0129	0.085
24 hr	84.3	118.0	0.113	0.0259	0.087
48 hr	96.2	134.7	0.130	0.0518	0.078

MAX Storage Required (m^3/m^2)	[D]	0.087	
Est. Attenuation Storage (m^3)	[E] = [B] x [D]	1,394	V_{Attn} = **1,394** m^3

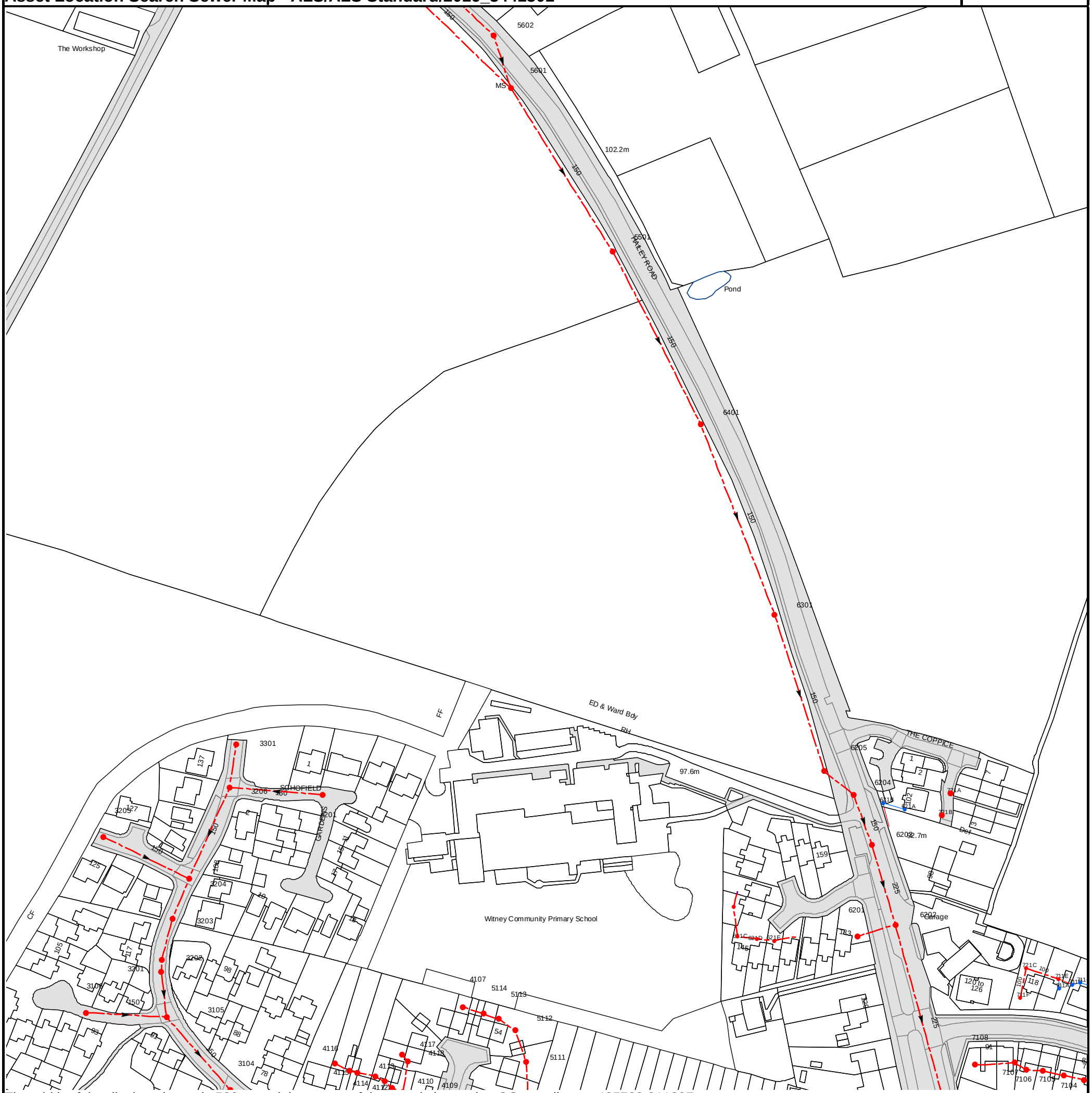
Total Storage Required

Total Storage = Inception Storage + Attenuation Storage

	[F] = [C] + [E]	1,474	V_{Tot} = **1,474** m^3

Appendix 2 Thames Water Asset Location Search Map

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3441301



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 435529,211397

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
721B	n/a	n/a
721A	n/a	n/a
621E	n/a	n/a
621D	n/a	n/a
621C	n/a	n/a
6201	n/a	n/a
6202	n/a	n/a
3203	98.47	95.56
621F	n/a	n/a
3204	98.69	95.87
6203	n/a	n/a
3205	99	96.97
621A	n/a	n/a
621B	n/a	n/a
6204	92.9	91.29
4201	n/a	n/a
3206	99.21	96.47
6205	94.12	93.03
3301	99.59	96.81
6301	96.49	95.27
6401	99.05	97.86
5501	101.56	100.34
5601	103.72	102.39
5602	103.97	n/a
4111	n/a	n/a
4112	n/a	n/a
4113	n/a	n/a
4114	n/a	n/a
4115	n/a	n/a
4116	97.18	96.31
5111	n/a	n/a
4118	96.7	95.84
4117	n/a	n/a
5112	95.81	95.4
5113	n/a	n/a
5114	n/a	n/a
4107	96.52	96.1
7103	n/a	n/a
7104	n/a	n/a
7105	n/a	n/a
7106	n/a	n/a
7108	92.7	91.96
7107	n/a	n/a
711F	n/a	n/a
711A	n/a	n/a
711B	n/a	n/a
711C	n/a	n/a
711E	n/a	n/a
721C	n/a	n/a
3106	98.41	96.41
3201	98.29	95.37
3202	98.33	95.44
3105	98.18	95.1

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

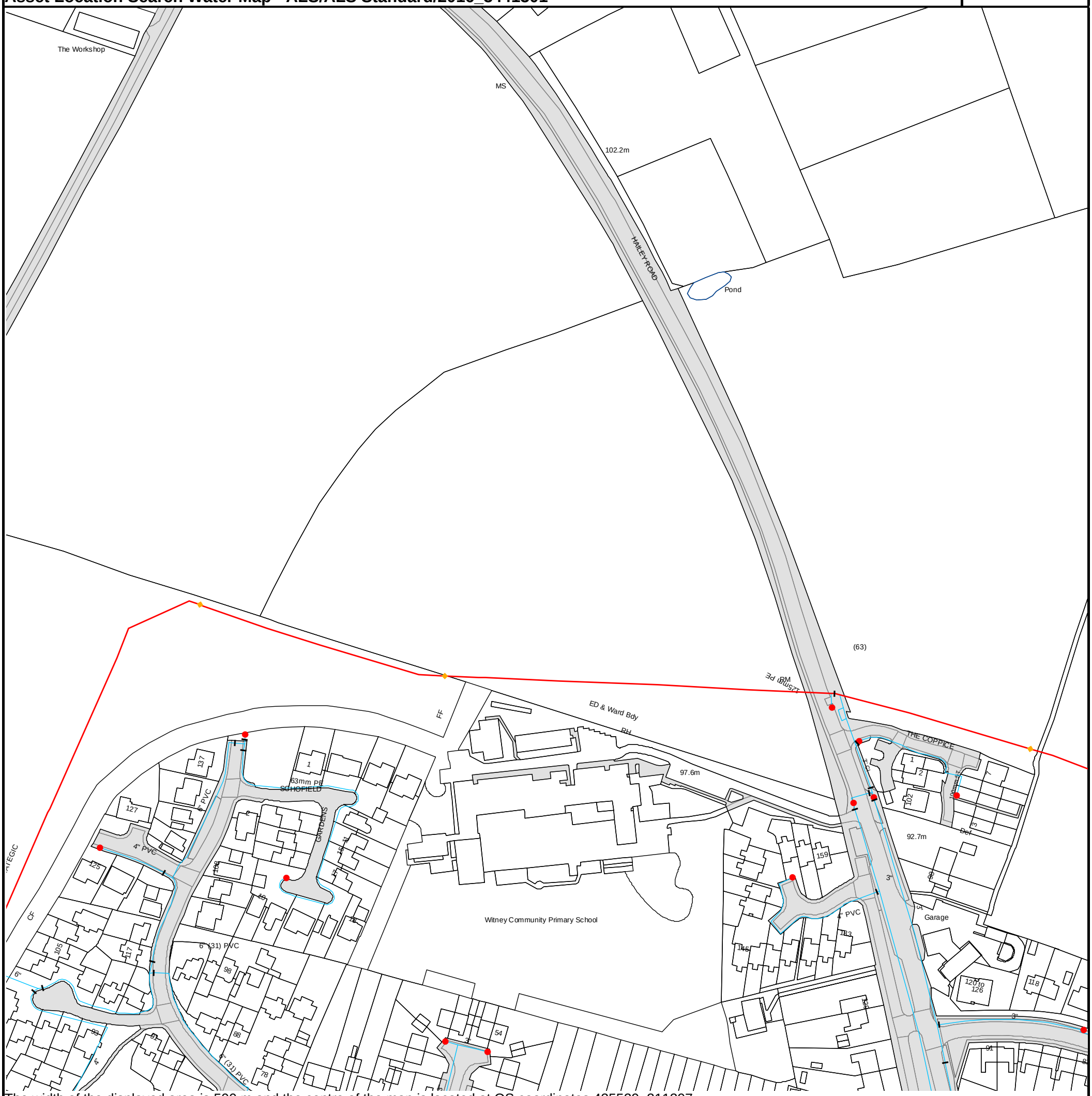
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2016_3441301



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ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.