Conclusions

Fairford has experienced significant fluvial flooding from the River Coln and Court Brook on a number of occasions and with a changing climate it is likely that such events will become more common. There have also been floods from surface runoff and from an overwhelmed sewer system.

As part of future planning, developers would fund independent studies to ascertain what additional sewerage works would be required to support proposed new development. This would take the form of scoping studies to identify the work required and cost of improvement which would then be undertaken by Thames Water.

There is no scope for SuDS drainage using infiltration in low-lying areas associated with the Coln alluvial corridor due to frequent high groundwater levels. In such conditions, attenuation storage ponds provided as a SuDS solution can only take the form of shallow depressions which would require significant land.

Ideally development would be directed away from the Coln and Court Brook corridor.

CIRIA guidelines emphasise that effective SuDS infiltration schemes would ensure that groundwater levels are at least 1 m below the bottom of soakaways. For sensitive sites at the preliminary planning stage, developers would provide a flood risk assessment with infiltration tests to confirm the suitability or otherwise of that site.

Glossary of Units, Terms and Abbreviations

m	metres
mm	millimetres
m bgl	metres below ground level
mOD	metres above Ordnance Datum
m AOD	metres above Ordnance Datum
Ha	hectare
catchment	area drained by a river
river gauging	point on the river where the rate of discharge is measured
GW	Groundwater
RWL	Rest water level
GWL	Groundwater level
T	Return period in years
T200	1 in 200-year event
GL	Ground Level
WT	Well Top
LiDAR	Surveying method using pulsed laser light
CIRIA	Construction Industry Research and Information Association
Freeboard	Vertical distance from water level to another reference point [usually ground level]
GIS	Geographic Information System
SMD	Soil Moisture Deficit
Soakaway	Cavity which allows water to drain into the ground rather than a sewer or mains drain pipe
GCC	Gloucestershire County Council
LLFA	Lead Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
uFMfSW	Updated Flood Maps for Surface Water [Environment Agency]
BGS	British Geological Survey
EA	Environment Agency
CDC	Cotswold District Council
NP	Neighbourhood Development Plan
LNR	Local Nature Reserve
SFRA	Strategic flood risk assessment
WILD	Water with Integrated Local Delivery [Project with Cotswold Water Park]
SuDS	Sustainable drainage systems

Glossary of Hydrogeological Terms

Alluvium. An unconsolidated accumulation of fluvially-deposited sediments, including sands, silts, clays, or gravels [typically deposited by rivers and streams in a valley bottom].

Aquifer -

[1] A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs [after Lohman and others, 1972].

[2] A geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs. Any saturated zone created by uranium or thorium recovery operations would not be considered an aquifer unless the zone is or potentially is [1] hydraulically interconnected to a natural aquifer, [2] capable of discharge to surface water, or [3] reasonably accessible because of migration beyond the vertical projection of the boundary of the land transferred for long-term government ownership and care [10 CFR Part 40 Appendix A].

[3] A formation, a group of formations, or a part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs [10 CFR Part 960.2].

[4] A zone, stratum, or groups of strata that can store or transmit water in sufficient quantities for a specific use [30 CFR Part 710.5].

[5] Geological formation, groups of formations, or part of a formation, that is capable of yielding a significant amount of water to a well or spring [40 CFR Parts 146.03; 260.10; 270.2].

[6] A geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs [40 CFR Part 257.3-4].

Artesian

Artesian groundwater refers to water in a confined aquifer which, when penetrated by a borehole, rises under hydrostatic pressure to a point above the top of the aquifer. Depending on the depth of the aquifer, the water may or may not overflow onto the ground surface. The word artesian comes from the town of Artois in France, the old Roman city of Artesium, where the best-known overflowing artesian wells were drilled in the Middle Ages. The level to which water will rise in artesian aquifers is called the piezometric surface.

Confined aquifer -

[1] An aquifer bounded above and below by confining units of distinctly lower permeability than that of the aquifer itself [ASCE, 1985].

[2] An aquifer containing confined groundwater [ASCE, 1985].

[3] An aquifer bounded above and below by impermeable beds or by beds of distinctly lower permeability than that of the aquifer itself; an aquifer containing confined groundwater [40 CFR 260.10].

Groundwater 1] all subsurface water as distinct from surface water [ASCE, 1985].
[2] All water which occurs below the land surface. It includes both water within the unsaturated and saturated zones [NRC, 1985].

Drawdown [1] The vertical distance the water elevation is lowered or the reduction of the pressure head due to the removal of water [after ASCE, 1985].
[2] The decline in potentiometric surface at a point caused by the withdrawal of water from a hydrogeologic unit [after Heath, 1984]
Head, static - The height above a standard datum of the surface of a column of water [or other liquid] that can be supported by the static pressure at a given point. The static head is the sum of the elevation head and the pressure head [after Lohman and others, 1972].
Hydraulic head - The height above a datum plane [such as sea level] of the column of water that can be supported by the hydraulic pressure at a given point in a ground water system. For a well, the hydraulic head is equal to the distance between the water level in the well and the datum plane [ASCE, 1985].

Hydrograph - A graph relating stage, flow, velocity, or other characteristics of water with respect to time [after ASCE, 1985].

Impermeable - A characteristic of some geologic material that limits its ability to transmit significant quantities of water under the head differences ordinarily found in the subsurface [after ASCE, 1985].

Infiltration - The downward entry of water into the soil or rock [SSSA, 1975].

Permeability - The property of a porous medium to transmit fluids under an hydraulic gradient.

Permeability coefficient - The rate of flow of water through a unit cross-sectional area under a unit hydraulic gradient at the prevailing temperature [field permeability coefficient] or adjusted to a temperature of 150C [60-F] [ASCE, 1985].

Piezometer - A devise used to measure groundwater pressure head at a point in the subsurface.

Piezometric surface - Potentiometric surface - An imaginary surface representing the static head of groundwater, defined by the level to which water will rise in a tightly cased well [after Lohman and others, 1972].

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1 Introduction

1-1 Background

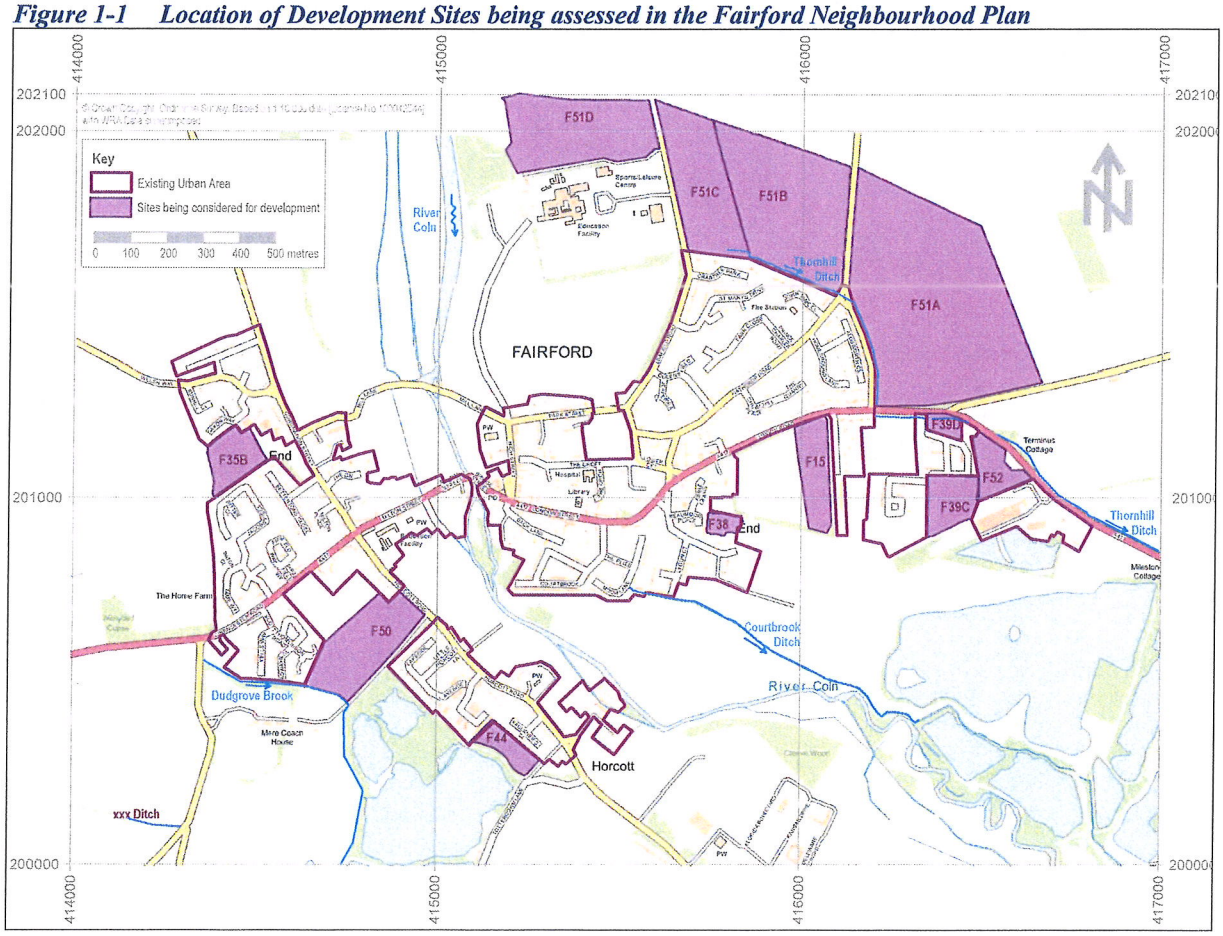
This report has been prepared following the scope of the FTC terms of reference included in Appendix A, taking into consideration a revised outline of sites under assessment.

The Fairford Neighbourhood Development Plan [NDP] was recently rejected by the examiner partly on the grounds that "insufficient hard evidence" had been provided to support the strategy that future housing development should be located on land away from the River Coln and river terrace deposits. The NDP Steering Group therefore commissioned this hydrological study to provide that hard evidence, through the investigation and monitoring of groundwater levels in areas representative of proposed development at Fairford. The work also included a review of documents produced by other consultants and utilities relating to recent flooding in the town.

It would appear that the River Coln flood risk has been improved through construction of a new bund and other infrastructure by the Environment Agency in 2013. The risk of localised surface water flooding at East End was significantly reduced when Thames Water cleared drains under London Road and cleared Court Brook in 2017. So, the focus of this assignment has been assessment of the groundwater levels in and around the town of Fairford, with particular attention to the south-west and north-east perimeters of the town.

The location of development being considered for the Fairford Neighbourhood Plan is shown in Figure 1-1. The sites being assessed conform with the CDC Local Plan.

Figure 1-1 Location of Development Sites being assessed in the Fairford Neighbourhood Plan



1-2 Objectives and Scope of Work

The scope of the work has included the following key activities:

- Collation and review of all relevant geological, hydrological and hydrogeological data and documentation available from the Environment Agency, the British Geological Survey and other relevant bodies, including records of groundwater and surface water levels, geological map and memoir, borehole records and flood-related reports.
- Reconnaissance of the town area to identify existing water wells and springs, discussion with owners and retrieval of records where possible, to produce an inventory of data and water levels.
- Analysis of LiDAR data and geological mapping to investigate lineaments and micro-relief of the town area and help locate proposed monitoring sites.
- Drilling of small diameter exploratory boreholes in two areas to determine water levels and formation thickness of the Cornbrash limestone and Summertown sand and gravel deposits.
- Construction of piezometers at two exploratory borehole sites for groundwater level monitoring.
- Installation of water level sensors and data loggers in a secure manner.
- Groundwater level monitoring for a period of three months.
- Hydrogeological analysis of long-term historical groundwater records and correlation with data captured by the new piezometers for prediction of conditions at potential development sites shown in Figure 1-1.
- Preparation of a draft report describing the results of the work, for comment by FTC.
- Preparation of a final report addressing FTC comments.

The main focus of the assignment has been on groundwater, but the report also includes a review of previous studies to assess comparative risk of surface flooding for sites close to the river and those further away.