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12th December 2022

Dear Sir/Madam

RE: Fairford Neighbourhood Development Plan – Regulation 16 Pre-Examination Consultation – Representation on behalf of Earlswood Homes

Introduction

1. This representation is submitted to Cotswold District Council on behalf of Earlswood Homes in relation to the Fairford Neighbourhood Development Plan Regulation 16 consultation.

2. Earlswood Homes have land interests in the Fairford Town Council area, specifically in respect of *"Pengerric"* and associated land east of Beaumoor Place, East End, and would welcome a continued and positive dialogue with the Neighbourhood Plan Group and the Town Council more generally as to the role which this sustainable site can play in meeting local housing needs and other objectives.

3. These representations therefore provide observations and comment on the Neighbourhood Plan as drafted, but also provide evidence to demonstrate that land east of Beaumoor Place, East End remains a suitable, available, deliverable and sustainable site for development, and one which can positively contribute to the future needs of Fairford. Earlswood Homes views land east of Beaumoor Place, East End as being complementary to the positive proposals already incorporated within the draft Neighbourhood Plan rather than seeking to compete with or replace those.

4. At the outset, it must be noted that Earlswood Homes continues to support Fairford Town Council's decision to continue to pursue a Neighbourhood Development Plan following the previous unsuccessful examination. In this context, our comments are made with the intention of being constructive and in the spirit of assisting and supporting the bringing forward a plan which is in the best interests of the Town, will meet the basic conditions and ultimately be capable of being 'made'.

5. These representations follow previous representations made on behalf of Earlswood Homes as part of the Regulation 14 consultation undertaken in November 2020. Much of the content of our earlier representations remains relevant now given there have been no discernible change to some of the substantive shortcomings with the earlier draft of the Neighbourhood Plan.

6. The representations also follow our representations and comments to the Cotswold Local Plan Partial Update: Regulation 18 'Issues and Options' Consultation in March 2022.

Representations on the draft Neighbourhood Plan

Community views and the needs of Fairford

7. We note the challenges identified in the Neighbourhood Plan regarding the ability of key infrastructure, including health services, to keep pace with both existing and future demand, and supporting the Town Council's objective to ensure that community facilities are updated and upgraded to ensure that they continue to cater for local social needs.

8. However, we believe that the Neighbourhood Plan can do more to proactively overcome these challenges for the benefit of the town. We are aware that there continue to be issues with parking pressures at Hilary Cottage Surgery due to the high demand for services and appointments.

9. Through the proposed allocation of land east of Beaumoor Place, the previous Neighbourhood Plan grasped an opportunity to provide additional public parking close to the surgery, helping to alleviate parking pressures on the surrounding roads and improve access to the surgery for those who may not be able to walk or travel by other means. At that time, the Examiner for the previous Neighbourhood Plan concluded in his report that *"the approach taken to this site [East End] is commendable. The Town Council has sought to address... the car parking needs of the doctors' surgery in Keble Lawns. This is entirely the type of proposal that is anticipated to be generated in a neighbourhood plan".*

10. We note from the Consultation Statement supporting the Regulation 16 consultation that the Town Council has questioned the public benefit of providing additional car parking capacity. This is unfounded. The demand for parking from the surgery is clearly driven by both surgery staff as well as patients. As the population within the catchment grows because of planned development, this demand – both from patient visitors and surgery staff – will only continue to increase as the surgery expands services to meet demand. This is particularly so given the Neighbourhood Plan acknowledges within its *Issues/Vulnerabilities* that *"the percentage of over 70's is likely to increase, and provision will be needed for their accommodation, health, and wellbeing."*

11. At present, it is widely accepted that parking provision at the surgery is inadequate; the previous Neighbourhood Plan accepted this. This results in parking from either patients/visitors and staff being displaced into surrounding roads on Keble Lawns and beyond, detracting from local amenity and creating inconvenience for both users and nearby residents. As above, this situation will only be exacerbated by increased demand.

12. Therefore, providing dedicated additional "off-street" parking capacity for the surgery is clearly a public benefit. Whether this capacity is used by staff (thereby avoiding the need for them to park on surrounding residential roads for long periods of time) or by visitors/patients as an alternative to

parking on-street, it will improve access to the surgery and avoid the current adverse environmental and neighbour amenity issues generated by regular and significant on-street parking. Furthermore, securing land for additional parking capacity now provides resilience for the future by planning ahead to ensure that the growing demand for services at the surgery can be accommodated without further detriment to the appearance and amenity of the area from excessive on-street parking.

13. We therefore strongly believe that the views of the previous Examiner in relation to the potential benefits of this opportunity remain valid. With the site now within Earlswood Homes' control, we remain committed to working with the Town Council, Doctor's Surgery, and other stakeholders to deliver a viable and feasible solution to the long-term parking needs of this key health facility and stand willing to deliver that solution on the land east of Beaumoor Place Being so close to the surgery, this is the optimal – perhaps even the only – site where this issue can be addressed.

14. The response of the Town Council within the Consultation Statement also questions the viability of providing additional car parking to the surgery. However, based on our experience from elsewhere, there are clear and practical solutions which would enable this additional parking capacity to be delivered without representing an unreasonable long-term liability for the Doctor's Surgery or wider public purse.

15. This could, for example, be addressed through the land being leased to the Doctor's Surgery for a token sum (e.g., a peppercorn) with Earlswood Homes (or an assigned Management Company) taking responsibility for long-term maintenance. Alternatively, the land could be gifted to the Doctor's Surgery (and/or the Town Council) together with an appropriate commuted sum for future maintenance and upkeep. Either of these options could be secured through a s106 legal agreement and would provide a certain, long-term solution for the provision and management of the car park.

16. Respectfully, there can therefore be no question as to the deliverability of, or public benefit arising from, the provision of additional Doctor's Surgery car parking which could be secured by bringing forward the land east of Beaumoor Place. These factors should not therefore be seen as a valid or justified reason not to allocate the site.

Vision Statement and Objectives

17. In general, Earlswood Homes **supports** the vision statement set out in the draft Neighbourhood Plan. We particularly **support** the aim to deliver development which is appropriate to the needs of residents, and which addresses demographic challenges faced by the town.

18. The draft Plan (at paragraph 2.40) acknowledges in very direct terms that *"Housing development in Fairford must meet the needs of an aging population"*. Whilst we agree with this acknowledgement, **we do not believe that the Neighbourhood Plan has a robust approach to meeting the requirements of this segment of the local population**, in accordance with the NPPF which identifies that plans must meet the needs of specific groups. In the Town Council's responses to our earlier representations (as set out within the Consultation Statement), it suggests that these needs can be met through windfall proposals and windfall applications outside of settlements. This does not represent an effective strategy for meeting needs, it is merely a reactionary approach which leaves actual deliver to chance. We set out further representations in this respect under FNP15 below.

19. Although we do not disagree with the overarching aims and objectives relating to housing provision and mix, as set out below, **we do not believe that the Neighbourhood Plan puts forward an effective, robust, or flexible strategy to deliver on these key housing objectives.** With a single site allocation to deliver its entire housing needs, the Plan is painfully reliant upon this single source of delivery, with no alternative should this site be delayed or be found to be unviable. This places unacceptable risk to the delivery of housing in Fairford, particularly given there is a demonstrable track record of historic allocations within the village proving undeliverable as was the case with both allocations within the current Cotswold Local Plan (at Milton Farm/Bettertons Close and rear of Faulkner's Close).

20. Whilst we note from the Consultation Statement that the Town Council suggests that this choice/resilience *"may be provided by additional windfall sites"* and in settlement infill which could come forward under existing policies, there is simply no evidence to demonstrate the scale of windfall/infill potential in the village. This reliance on an uncertain supply of potential windfalls does not represent a positive or proactive approach to meeting village housing needs.

21. We address this further under FNP14 below and maintain our position that further small site allocations must be made within the FNP to complement the allocation at Leafield Road / Hatherop Road and to provide an effective and reliable strategy for meeting housing needs. We believe such additional allocations (5-15 units) should include land east of Beaumoor Place given the potential range of benefits this site can offer – as acknowledged by the previous Examiner.

FNP1 – Development Boundaries

22. We **object** to the proposed definition of the Development Boundary at Fairford.

23. Previous iterations of the Neighbourhood Plan have, in our firm view, rightly drawn the development boundary of the village to include the land east of Beaumoor Place as falling within the settlement boundary.

24. However, through this Regulation 16 draft, the Development Boundary has been amended to exclude land east of Beaumoor Place with the Town Council seemingly alleging in the Consultation Statement that this was an *"unintentional carry-over from the previous draft Plan"*. This approach results in an illogical and contrived boundary, seemingly driven solely by the alleged lack of development potential of the land. In our view, the Development Boundary should instead be about defining a natural and logical envelope to the village, informed by an understand of character and land use "on the ground".

25. In this regard, we have not seen any robust evidence or justification for the definition of the revised Development Boundary within the draft Neighbourhood Plan beyond the alleged *"unintentional carry over"*. Instead, we strongly maintain that the boundary, as previously drawn to include land east of Beaumoor Place reflects a logical and appropriate built envelope for the town.

26. To further illustrate the inconsistency in approach, the Council have – despite withdrawing the allocation from the undeliverable land at Faulkner's Close – maintained this land within the Development Boundary. This clearly demonstrates that land does not have to be developable to be recognised as part of the natural envelope of the village. The land at Faulkner's Close is otherwise

undeveloped whereas the land east of Beaumoor Place forms part of the residential plot of *"Pengerric"*, part of which has been defined as falling within the Development Boundary.

27. The above demonstrates the shortcomings in the definition of the Development Boundary which, we believe, are born from a lack of any meaningful evidence or criteria being applied to the process.

28. We would suggest that FNP1 and the associated Development Boundary shown on the Policies Map (Map B) in the draft Plan are amended to include land east of Beaumoor Place. The definition of the boundary should not be driven by a cynical attempt to reinforce the Town Council's view on the developability (or otherwise) of a site; ultimately, should the views about the constraints on the land prove correct, they would still preclude the site being developed whether or not it is within the Development Boundary.

FNP2 – Providing a New Burial Ground

We have no comments to make in relation to this policy.

FNP3 – Maintaining viable community facilities

29. Earlswood Homes **support** the desire of the Town Council to protect and enhance specific important community facilities for the benefit of the residents of Fairford. Such community facilities are an essential and integral part of a thriving and healthy community and what makes the village an attractive place to live and work.

30. However, we believe FNP3 could – and should – go further to actively promote the objective of delivering improved community facilities for Fairford beyond just those listed in the policy. As per our previous representations, Earlswood Homes continue to suggest that an additional provision is added to FNP3 along the following lines:

    P3.1A Proposals for new development which would enhance the quality of, or access to, existing community facilities or their ability to meet the needs of Fairford in the longer term will be strongly supported.

31. Whilst we acknowledge that, in their Consultation Statement, the Town Council suggest that this is captured by other local or national policies, a provision of this nature in FNP3 would provide a positive local statement as to the weight that would be ascribed locally to such benefits and would provide it with a clear mechanism to influence planning decisions in a positive manner. This change would link directly back to Objective 4a. earlier in the draft Plan and would reinforce the Council's response in the Consultation Statement which confirms that *"it is a constant aspiration of Fairford Town Council to support improved community and other facilities in the town"*.

FNP4 – Managing flood risk

32. We welcome the approach in FNP4 which seeks to appropriately balances the need to avoid flood risk where possible whilst providing the flexibility for schemes to be individually justified in respect of flood risk. This is consistent with the sequential approach and flood risk assessment requirements in national policy.

33. However, we continue to **object** to FNP4.4 relating to the approach to groundwater risk. Our earlier objections on this matter still stand.

34. Policy FNP4.4 applies, in effect, a blanket ban on any site in an area of higher groundwater risk if it cannot deliver sustainable drainage. This approach is unjustified, not consistent with the Cotswold Local Plan or national policy and not borne out by the evidence which supports the plan.

35. Policies at both the national level and local level (Cotswold Local Plan EN14) rightly seek to encourage sustainable drainage systems. However, neither national or local policy state that – where sustainable drainage systems are technically unfeasible or otherwise inappropriate, development cannot occur or should be refused. Indeed, Paragraph 167(c) and 169 of the NPPF both recognise that - in some cases – it might be proven that the use of sustainable drainage systems might be inappropriate; however, neither paragraph then suggests that development should simply be refused.

36. As drafted, Policy FNP4.4 makes a "leap of faith" and is unduly restrictive in its approach. It is clearly not in conformity with higher order policy.

37. We do not dispute that groundwater risk is an important consideration locally, and that careful attention would need to be paid to surface water drainage design in such locations to ensure that it is compatible with, and appropriate to the groundwater and hydrological conditions of the site. In some cases, that may mean that techniques such as infiltration may not be achievable. However, given local and national policy recognise there are instances where SuDS may be inappropriate, this should not render development unacceptable in principle as there may be other perfectly viable solutions to managing surface water in line with the SUDS hierarchy.

38. We therefore continue to suggest that FNP4.4 be reworded as follows:

    P4.3 Where development is proposed on land identified by the Environment Agency as lying within Flood Zone 1 but that is shown by appropriate evidence to be subject to high groundwater levels, careful attention will need to be given to the management of surface water.

    Proposals will only be supported where it can be demonstrated through robust evidence that surface water can be managed effectively, in a manner which is compatible with the hydrological conditions of the site and that the drainage solution will not give rise to increased groundwater or other flooding on the site or in the surrounding area.

    Where this is not demonstrated satisfactorily, permission will be refused.

39. The above change would, in Earlswood Homes view, appropriately reflect and acknowledge this important local issue but also give flexibility for it to be addressed on a site by site basis in a way which is consistent with higher order local and national policies. It would address the present non-compliance with basic conditions for Neighbourhood Plans.

40. Furthermore, we note in relation to land east of Beaumoor Place that the Town Council's response in the Consultation Statement identifies that *"groundwater levels in Fairford vary significantly over*

longer periods" and that *"there does not yet seem to be sufficient evidence to give confidence in the deliverability of a scheme"*. In this regard, since our earlier representations, Earlswood Homes have undertaken 12 months of site-specific groundwater monitoring on the land east of Beaumoor Place (January 2021 to January 2022). This site-specific evidence – which is clearly preferable and more robust than extrapolated assumptions based on boreholes elsewhere in the village (190 and 280m from the site), is summarised within the updated Flood Risk Assessment and Outline Drainage Strategy at Appendix C and has been used to develop and outline strategy. As can be seen, the FRA concludes that *"the groundwater flood risk can be mitigated and managed by the proposed development with minimal impact to those on site"* and that *"the development of the site with the proposed drainage system does not pose an unacceptable flood risk either to occupants of the site or to others off the site."* We discuss this further below as part of our critique of the Site Selection evidence which underpins the draft Neighbourhood Plan. However, ultimately, this site-specific evidence and strategy provides the "confidence" needed to demonstrate the deliverability of a scheme on land east of Beaumoor Place.

FNP5 – Investing in Utilities Infrastructure Improvements

41. We **object** to this policy. Specifically, we have serious concerns as to the practicality and enforceability of the types of restrictions, conditions and measures set out in FNP5.4.

42. It is essential that the Neighbourhood Plan has a realistic approach when it comes to infrastructure needs which are fundamental to the deliverability of development. Clarity as to the timing of infrastructure delivery must surely be expected up front and cannot be left to planning conditions. The prospect of commencing a development without certainty as to how and when new homes may be able to be occupied (or the timing of occupation being at the behest of the agreement of a third party) presents a serious viability risk to the developer. We seriously question the practicality of suggested alternatives (such as tankering) for any length of time or for any significant number of dwellings.

43. Furthermore, we note (including by reference to FNP14), that – due to the size of the scheme – the delivery of the proposed single site allocation is dependent upon proposed sewerage infrastructure upgrades (FNP14.2(a)) but that these upgrades *"are not currently committed but awaiting decisions by Thames Water"*. Given there is currently no commitment to deliver these upgrades, this further calls into question the deliverability of the strategy within the Neighbourhood Plan. In contrast, we note that – at paragraph 6.31 in the Neighbourhood Plan – it is recognised that whilst there is limited capacity in the STW, there is scope for smaller developments of less than 15 units which are *"not likely to require local network improvements"* and that only larger proposals *"in the region of 50-100 units may trigger the need for larger upgrades at the STW."* This infrastructure constraint further calls into question the appropriateness of a strategy reliant on a single, large (80 unit) allocation and supports our suggested approach of introducing some complementary smaller allocations which can be brought forward without the need for substantial infrastructure upgrades, enabling a steady supply of homes until the main allocation can be delivered.

FNP6 – Managing Traffic in the Town

44. We recognise and support the importance of managing the transport impacts of new development within the town, and broadly speaking, do not take issue with the aims that the policy is seeking to achieve.

45. However, we continue to strongly **object** to the inclusion of a pre-determined threshold requiring Transport Assessments on all development of 10 units or more or exceeding 1,000sqm.

46. This approach is unduly onerous, not evidence based and is not in line with national policy. National policy requires that Transport Assessments are undertaken where the development would *"generate significant amounts of movement"* and there may be cases where developments exceeding 10 units do not generate significant movements (for example in relation to certain forms of specialist housing where there is reduced parking provision). No evidence has been provided to justify how the threshold has been arrived at (other than presumably that it crudely based on the definition of "major development").

47. Ultimately, as reflected in national policy, it is important that transport evidence that is proportionate to the nature, scale and potential impact of the scheme. Policy FN6 does not reflect this. Furthermore, in many cases, this policy requirement is likely to result in smaller developments (and smaller/SME developers) being subjected to additional and disproportionate cost to prepare unnecessary evidence to support development proposals.

48. We continue to suggest that reference to 10 or more homes or 1,000sqm is removed, and replaced with the wording in national policy – i.e. *"developments that will generate significant amounts of movements"*.

49. Furthermore, the purpose and expectations of the policy are unclear. For example, the policy (and supporting text) suggests that such assessments might be expected to cover issues such as vibration, pollution, and structural impacts on roadside heritage buildings; however, this is far beyond the scope of a Transport Assessment and strays into other specialist assessments. Such evidence would, for anything other than a very significant level of traffic generation or a high degree of HGV movements, be wholly excessive in our opinion. The lack of clarity as to the scope of the policy makes it ineffective.

50. Alternatively, the policy should – as a bare minimum – be altered so that it instead requires a Transport Statement or Transport Assessment which identifies and quantifies the effects of traffic generated by the scheme in a manner proportionate with the scale and nature of the proposals. The alternative wording could therefore be:

    Proposals for residential schemes of 10 or more homes or for non-residential schemes of more than 1,000sqm gross internal area must be supported by a Transport Statement or Transport Assessment.

    This should include proportionate evidence regarding the likely traffic generation including, where appropriate, in combination with other consented or allocated schemes, and any resulting effects on roads within the Fairford Conservation Area.

FNP7 – Improving Access to Visitor Attractions

We have no comments to make in relation to this policy.

FNP8 – Protecting Local Green Space

We have no comments to make in relation to this policy.

FNP9 – Protecting the Fairford-Horcott Local Gap

We have no comments to make in relation to this policy.

FNP10 – River Coln Valued Landscape

We have no comments to make in relation to this policy.

FNP11 – Valuing Hedgerows and Trees

We have no comments to make in relation to this policy.

FNP12 – Achieving High Standards of Design

We note that this policy has evolved considerably since the earlier Regulation 14 draft Neighbourhood Plan, informed by the preparation of the Fairford Character & Design Assessment.

We have no comments to make in relation to this policy; however, we would suggest that the key views listed in Appendix 3 are transposed onto a plan to provide clarity and avoid ambiguity as to their location and scope/extent.

FNP13 – Conserving Non-Designated Heritage Assets

Whilst we support the principle of identifying non-designated heritage assets which contribute to the rich tapestry of local history and architectural interest.

However, we **object** to the approach taken to assessing impacts upon these locally identified non-designated heritage assets. In requiring a *"public benefit that outweighs the harm or loss"*, Policy FNP13.1 is out of step with national policy which – in respect of non-designated heritage assets – requires a *"balanced judgement...having regard to the scale of any harm or loss and the significance of the heritage asset"* (Paragraph 203). The effect of the approach advocated in FNP13.1 is to – in effect – elevate the status of these non-designated assets to that of a designated heritage asset, by requiring a public benefits test which is similar in scope and nature to paragraph 202 of the NPPF. In doing so, FNP13.1 fails to give proper regard to national policy and the basic premise of a hierarchy of significance whereby *"the more important the asset, the greater the weight should be"* (NPPF para 199).

We would therefore suggest that FNP13.1 should be amended to reflect national policy as follows:

The FNP identifies the buildings and structures, as listed in Appendix 2: List of Non-Designated Heritage Assets and shown on the Policies Map, as Local Heritage Assets by way of their local architectural or historic interest.

Great weight will be given to the conservation of these buildings and structures. Development will be required to protect, and wherever possible enhance, these assets including their setting. In considering proposals that directly or indirectly affect non-designated heritage assets, a balanced judgement will be taken having regard to the scale of any harm or loss and the significance of the asset.

These changes are, in our view, necessary to ensure that the Neighbourhood Plan is consistent with national policy and meets the Basic Conditions.

FNP14 – A New Low Carbon Community in Fairford

51. Earlswood Homes does not object in principle to the proposed allocation of land between Leafield Road and Hatherop Road for a low, or zero, carbon residential development.

52. However, as previously stated, we have several concerns in relation to the draft Neighbourhood Plan being predicated and reliant upon this site as the sole allocation for delivering on the Town's housing needs. These have not been addressed between the Regulation 14 draft and the current proposed Submission Neighbourhood Plan. These concerns go to the heart of the strategy of the Neighbourhood Plan.

53. Firstly, whilst we commend the aspiration and high standards which the policy seeks to impose on development on this site, we continue to question whether any robust viability testing has been carried out at this stage to confirm that an allocation would be deliverable in the face of these policy requirements. This is a point which we raised in our Regulation 14 representations, and this does not appear to have been addressed. Certainly, we have been unable to locate any form of viability appraisal or assessment amongst the documents published to support the submission Neighbourhood Plan. We note also that, in their 2019 Site Assessment Report, AECOM (on behalf of Fairford Town Council), clearly advised that *"Sites to be taken forward for the purpose of the Neighbourhood Plan will be considered and chosen by FTC on the basis of... viability studies"*. The absence of any robust viability appraisal of the single chosen allocation is therefore a serious shortcoming and – without it – there remain unanswered questions as to the deliverability.

54. The importance of viability testing is – in our view – elevated given:

    a. The reliance on a single allocation to deliver housing needs of the village;
    b. The track record, as discussed above and acknowledged within the NP itself, of previous allocations in the village (at Faulkner's Close and Milton Farm/Bettertons Close) proving to be unsuitable, undeliverable and unviable post allocation
    c. The extent of requirements being imposed on the allocation within FNP14.2, not least the overarching requirement to be low/zero carbon but also the requirement to make provision for a link road to the A417 and dropping-off point for local schools potentially carry considerable cost and viability implications, particularly when combined with wider requirements in relation to Building with Nature Standards, housing mix and affordable housing.

55. Hence, without proper testing, we remain extremely concerned that the level of requirements imposed could seriously jeopardise the overall viability of development on this site. As above, given this is the sole housing allocation within the FNP, we are concerned that non-delivery would undermine the entire basis of the draft Neighbourhood Plan and could result in housing needs not being properly satisfied.

56. Furthermore, the allocation ties development of the site to the completion of necessary infrastructure upgrades, including to Fairford Sewage Treatment Works which was identified in the

Cotswold Water Cycle Study as having limited spare capacity and, as a result, that larger development (50-100 units) may trigger the need for larger upgrades to the STW.

57. The Neighbourhood Plan even acknowledges that the upgrades upon which this allocation is reliant are *"not currently committed but awaiting decisions by Thames Water"* and that as a result *"the scheme is unlikely to contribute to meeting the district's five-year supply of housing until later in the plan period"*. This further illustrates the level of uncertainty regarding the delivery of the sole allocation within the plan. There is no alternative or fall-back strategy to meet housing needs in the short term should this occur. At the very least, the NP accepts that this development will not come forward for at least five years, leaving a situation in the meantime where there is no positive plan for continued delivery of much needed new housing other than through limited windfall and infill developments.

58. In line with Government research, focus on a larger allocation rather than smaller sites could result in slower delivery rates for housing as there is little competition within the market. A single allocation also does not provide choice to existing and future residents, some of whom may not wish to live within a larger development or may not be able to afford the higher up-front cost that could come from low/zero carbon homes.

59. In this regard, we remain gravely concerned that there there is a lack of resilience, realism, and flexibility within the strategy for delivering on the housing needs of the Town. Earlswood Homes suggest this could be rectified by including additional allocations of smaller sites which can be delivered without constraint and in the short term to complement the longer-term delivery of the flagship allocation at Leafield Road/Hatherop Road.

60. We maintain our view that one or two complementary allocations of sites of 5 to 15 units would provide sufficient selection to promote competition, as well as offer opportunities for SME developers as the NPPF specifically encourages. These allocations would provide resilience to the overall strategy for the delivery of housing in the FNP so that there is a positive plan for housing delivery within the first five years of the NP period, and to sustain any potential further delays to the main allocation should they arise. Developments of this site would also fall under the threshold at which the Water Cycle Study anticipated that local sewerage network improvements would be required (see 5.12 in the Neighbourhood Plan).

61. In this regard, we reiterate our view that Land east of Beaumoor Place, East End, which is within Earlswood Homes control, is a suitable, sustainable, and viable site to complement the existing allocation and should be considered as one of these additional allocations.

62. Furthermore, as explained further below, given the wide range of policy requirements proposed for FNP14, we question whether it will also be able to deliver housing for, or even adapted to, older people given this could add additional cost burdens. Indeed, the Town Council's response within the Consultation Statement to our earlier Reg 14 representations recognises and accepts that *"the FNP14 site is not particularly suitable for elderly people because of its location"*. An alternative solution to meeting the clearly recognised need for housing for an aging population in Fairford should be considered.

FNP15 – Housing Type and Mix

63. In general, we welcome all aspects of this policy, acknowledging that each element of it is clearly geared towards addressing a particular local issue. This locally tailored approach is commendable and is the purpose of Neighbourhood Planning.

64. We particularly support the recognition of an emphasis on two and three-bedroom houses, in response to anticipated local need.

65. However, we consider that the draft Neighbourhood Plan needs to go further in addressing the issue of housing for an aging population, and should do this in a more positive, direct, and proactive manner. This is the basis of our **objection** to this policy.

66. This is particularly so given the NP recognises, as set out above, that *"Housing development in Fairford must meet the needs of an aging population"* and the supporting evidence summarised in the justification for this policy identifies *"an under-supply of bungalows (particularly 3 bed) and retirement home places"* as well as more rapid growth in older age cohorts in the Cotswolds than elsewhere in the country. The evidence points to this being a key local issue which should be tackled positively, rather than through more passive measures.

67. Whilst we acknowledge that FNP15 seeks to support developments that implement Lifetime Homes criteria, there is no guarantee that this will result in the delivery of Lifetime Homes, or that such homes will not simply end up being occupied by families rather than older people or members of the community who need them most.

68. Furthermore, we note that the sole allocation in the plan (FNP14) does not include any specific requirements for the development to incorporate housing for older people, or even housing which is suited to an aging population. Indeed, the Town Council even acknowledges within the Consultation Statement that this site allocation is *"not particularly suited for elderly people because of its location"*. As alluded to above, given the other high standards which are set in the policy for the land between Leafield Road and Hatherop Road, we question at any rate whether it would be viable for that development to support further specific requirements to deliver housing for older people (or even to meet the Lifetime Homes aspiration in FNP15).

69. In this context, we maintain our view that the Neighbourhood Plan as currently drafted falls a long way short of providing a clear and effective strategy to address this important local need, particularly given it is a central part of the plan's vision (*"the demographic challenges faced by our rural area have been met by development appropriate to the needs of residents"*). Simply leaving this to chance through uncertain and unplanned windfall development is not proactive or effective; an alternative solution needs to be found for the plan to comply with national policy.

70. As a minimum, we repeat our suggestions that FNP15 should be amended to give specific policy support for age-restricted and retirement housing, and to developments including bungalows, to give leverage in, and influence over, planning decisions for such developments. We believe the following wording ought to be inserted into FNP15 as a minimum:

P15.4a *Proposals for new housing for older people, including retirement and age-restricted housing, in appropriate locations and proposals for bungalows will be strongly supported.*

71. Beyond this, we believe that it is imperative that the plan includes at least one specific site allocation to meet the needs of older people and encourage the Town Council to seriously consider this as a means of actively and directly addressing this key local challenge.

72. This could be achieved through specially designed, age-restricted housing – ensuring the homes are not only suited to older residents but remain available to them through enforceable planning conditions/obligations. Given it is accepted that this cannot realistically be achieved on the current site allocation due to its inappropriate location, we believe that proper consideration should be given to our suggestion, in line with the aspirations of the previous Neighbourhood Plan, to delivering housing for older people on land east of Beaumoor Place, East End as part of a mixed residential development. The site is suitably located for housing for older people, being close to health services and within walking distance (and a relatively flat walk via Beaumoor Place) of shops and services on the High Street, and ideally suited to meet these needs. Our Illustrative Sketch Scheme demonstrates how such a development could be achieved, whilst also incorporating much needed bungalows.

FNP16 – Zero Carbon Buildings

We have no comments to make in relation to this policy.

The role which development of "Pengerric" and land east of Beaumoor Place, East End can play in complementing the draft Neighbourhood Plan

Introduction and benefits

73. As above, Earlswood Homes have land interests within the Fairford Neighbourhood Plan area, holding a controlling option over Pengerric and land east of Beaumoor Place, East End. We remain committed to working with the Town Council and District Council to promote and secure development of the site which we strongly believe continues to offer significant, multi-faceted benefits for the local area which are not met through existing policies in the draft Plan, and some of which cannot be met anywhere else within the Town.

74. Specifically, and as shown on the illustrative Masterplan and Design Precedent Study appended to this representation, Earlswood Homes are promoting land east of Beaumoor Place of East End for a development of:

    a. 10 new homes, including 5 retirement / age-restricted properties designed to meet the needs of older residents locally
    b. Space for additional car parking for Hilary Cottage Surgery to alleviate existing parking pressures and improve access for all users
    c. New connection to the existing footpath through Beaumoor Place
    d. New public open space between the development and Morgan Hall to protect the setting of this heritage asset and maintain a semi-rural feel along the existing public right of way
    e. Designed to reflect Cotswold vernacular, with building heights no greater than 1.5 storeys to minimise visual and landscape impacts (see Design Precedents Study)
    f. Appropriate surface water drainage to manage run-off and ensure that there would be no increased risk of groundwater or pluvial flooding on site or elsewhere

75. As acknowledged by the Examiner of the previous Fairford Neighbourhood Plan, development of this site – and the delivery of the multiple local benefits it can secure – is exactly what Neighbourhood Plan's should be seeking to achieve. We repeat our strong belief that development on this site would:

    a. Complement rather than compete with the larger allocation at Leafield Road / Hatherop Road, providing flexibility and resilience within the overall housing strategy in the FNP;
    b. Make a positive and active contribution towards meeting the housing needs of older people, in a suitable and sustainable location; and
    c. Represent the only realistic option for addressing on-going parking shortage and pressures at Hilary Cottage Surgery in a location which is close to, and can be connected with, the surgery.
    d. Through sensitive design, offer opportunities to preserve and - through demolition of the poor quality, derelict bungalow *Pengerric* – enhance the setting of the Conservation Area and other heritage assets.

76. Land east of Beaumoor Place, East End is suitably located for housing for older people and for housing generally, being close to health services and within walking distance (and a relatively flat walk via Beaumoor Place) of shops and services on the High Street.

77. Whilst we note that questions have been raised regarding the practicality/deliverability of providing additional car parking to the surgery, there are simple solutions which would enable this additional parking capacity to be delivered without representing an unreasonable long-term liability for the Doctor's Surgery or wider public purse.

78. As set out above, this could, for example, be addressed through the land being leased to the Doctor's Surgery for a token sum (e.g., a peppercorn) with Earlswood Homes (or an assigned Management Company) taking responsibility for long-term maintenance. Alternatively, the land could be gifted to the Doctor's Surgery (and/or the Town Council) together with an appropriate commuted sum for future maintenance and upkeep. Either of these options could be secured through a s106 legal agreement and would provide a certain, long-term solution for the provision and management of the car park.

79. As above, we maintain that there are demonstrable public benefits to the provision of additional off-street car parking capacity for the Doctor's Surgery, both now but also for the long-term to ensure that this important local health facility is ready to accommodate additional demand as the village grows in the future.

80. Through our representations at Regulation 14 stage, we provided additional evidence in the form of a Sketch Scheme/Masterplan (Appendix A), Heritage Feasibility Study (Appendix B) and Flood Risk Assessment/Outline Drainage Strategy (Appendix C) which demonstrated how the perceived constraints on this site could Ae overcome. This reflected the conclusions in the AECOM Site Assessment Report (2019) which identified that Land east of Beaumoor Place could be considered potentially suitable subject to resolving various constraints.

81. We do not believe that this evidence has been given due consideration. Furthermore, whilst the site has now been assessed as a *"reasonable alternative"* within the SA/SEA which supports the Neighbourhood Plan, there are material errors in fact which have undermined the conclusions in relation to the site. We discuss these below and – for clarity – repeat our evidence/submissions at Regulation 14 stage where these remain relevant.

Fairford Neighbourhood Plan – Site Selection

82. Earlswood Homes have reviewed in detail the evidence supporting the Neighbourhood Plan, and particularly the selection of sites therein. Whilst agreeing with some aspects of the evidence, we strongly disagree with the conclusions reached in others, and the reasons for not selecting the site as an allocation despite it having been included within the previous iteration and having received a strong endorsement within the Examiner's Report.

83. To support our position, and to amplify the points set out below, Earlswood Homes have commissioned the following studies which support our representations and demonstrate that the main constraints can be overcome. These representations should be read in conjunction with this supporting evidence.

    a. Sketch scheme/Masterplan (by Earlswood Homes)
    b. Design Precedent Study (by Earlswood Homes)
    c. Heritage Feasibility Study (by Pegasus Group)
    d. Flood Risk Assessment and Outline Drainage Strategy (by GH Bullard)

AECOM Site Assessment Report – 2019

84. We note that the AECOM Site Assessment Report has been reviewed or updated following the evidence which we provided at Regulation 14 stage in relation to overcoming the perceived constraints of the site.

85. We welcome with the overarching conclusion that the site is potentially suitable providing constraints can be overcome. However, we provided in our Regulation 14 representations robust and comprehensive evidence which demonstrated how these constraints could be overcome. We would have anticipated that, as a bare minimum, this would have been reflected upon and the Site Assessment Report updated as appropriate. We do not consider the cursory responses from the Town Council in the Consultation Statement are sufficient to rebut our robust, site-specific evidence.

86. We reiterate our prior comments so that these can be properly reconsidered.

Access

87. With respect to access, this would be taken from East End with a new access road created following demolition of the derelict, poor quality bungalow *Pengerric.* Earlswood Homes option agreement encompasses both the bungalow and the land to the north, and therefore it has the necessary control to deliver an access via this route. Whilst it is acknowledged that East End does narrow once beyond the site, there is sufficient carriageway width to provide an suitable access to the site, and adequate sight lines (commensurate with speeds on East End) and appropriate junction geometry

can be achieved. There is therefore no legal, technical or highway safety impediment to access via East End. The references from the Cotswold District Council SHELAA to the site being "landlocked" are not accurate.

88. In addition to access via East End, the sketch layout proposes a pedestrian footpath through the site – linking East End to the existing public right of way along the northern boundary of the site with Morgan Hall. This will provide connectivity and permeability through the site, providing an alternative off-road pedestrian route for existing and future residents.

89. We disagree with the view expressed at 4.140 of the Site Assessment Report that the site has poor access to the town centre. As the Report acknowledges, the site is close – within walking distance of the town centre. The walking route is relatively flat (via Beaumoor Place in particular) and there are calming measures along the A417 (such as near the Library) which slow traffic speeds and provide dropped kerbs/tactile paving which provides a safe opportunity for all users to cross the road. As not all services are in the town centre (such as the Doctor's Surgery) it is almost inevitable that no matter where growth is placed, the A417 may need to be crossed. Unlike other sites north of the A417, land east of Beaumoor Place, East End clearly offers much closer and safer access to – for example – the main Doctor's Surgery.

Heritage

90. Earlswood Homes recognise that the site is located within the Fairford Conservation Area and near other designated heritage assets including Morgan Hall and Moor Farmhouse. In this respect, it is agreed and accepted that heritage does represent an important constraint and that any future development will need to be sensitive to the preservation of such assets and their settings.

91. The Town Council continue to place significance reliance on the comments of Cotswold District Council's Conservation Officer in relation to a 2017 planning application on the site. However, whilst these comments are acknowledged and respected, they are made in relation to a different development proposal compared to that now proposed. Furthermore, they are made without the benefit of, or any opportunity to review, our Heritage Feasibility Study which is discussed further below.

92. Furthermore, heritage issues would have been a consideration when the site was previously proposed for allocation through the earlier iteration of the Neighbourhood Plan. The same issues, constraints and relationships which existed then still exist now, yet – at that time – they were clearly not identified as precluding development.

93. Heritage issues were clearly and thoroughly considered by the Examiner and, whilst recognising that heritage was an important consideration to be addressed through the development management process, the Inspector ultimately concluded that on the basis of the information available, he was *"satisfied that there is potential to address these matters in a satisfactory way"* and that *"the proposed demolition of Pengerric to create vehicular access has the clear potential to enhance the character and appearance of the Conservation Area"*. We strongly support and endorse these conclusions which we believe remain valid.

94. To support this position, we have commissioned a Heritage Feasibility Study which is appended to this representation. This study appraises the significance of the relationship, and potential impacts, upon the various heritage assets covering and adjacent to the site as identified in the AECOM Site Assessment Report. The key points to note are:

    a. The undeveloped areas of the site make a very small contribution to the character and appearance of the Conservation Area.
    b. The derelict bungalow is an incongruous feature and detracts from the character and appearance of the area.
    c. Development would result in a very small amount of harm to the character and appearance of the Conservation Area but would also deliver improvements through demolition of the bungalow.
    d. The site makes no demonstrable contribution to the heritage significance of Grade II listed Morgan Hall or Grade II listed Moor Farmhouse through setting. The development will cause no harm to either through change to setting.
    e. The small amount of harm to the Conservation Area can be outweighed by the benefits of development (including new homes, retirement housing and the surgery car park)

95. From the above, it is clear that – whilst heritage is an important consideration – development of the site would give rise to very low levels of harm to heritage assets. This harm can be mitigated through design and would be outweighed by the considerable benefits of development as set out above. Earlswood Homes therefore rejects Cotswold District Council's SHELAA conclusion (as recounted in the Site Assessment Report) that development would have an unacceptable impact on Morgan Hall and the Conservation Area. Although important, heritage assets do not render this site unsuitable for development.

96. Our sketch scheme illustrates that the development would be sympathetic to the heritage assets and character more generally (as per the Design Precedent Study), with building heights limited to 1.5 storeys, provision of significant public open space, and landscaping and design to reflect the Cotswold vernacular.

Flooding and groundwater

97. We note the comments in the Site Assessment Report on this matter. Allied to our representations in respect of Policy FNP5, we disagree that groundwater conditions are an absolute constraint to development of this site.

98. Furthermore, we note that the Town Council's response in the Consultation Statement supporting this Regulation 16 consultation considers that *"It is well established that groundwater levels in Fairford vary significantly over longer periods. There does not yet seem to be sufficient evidence to give confidence in the deliverability of a scheme."*

99. In our earlier Regulation 14 representations, we provided a Flood Risk Assessment and Outline Drainage Strategy which sought to demonstrate how the site could be bought forward safely and without increasing flood risk elsewhere, even taking account of the hydrological and ground conditions on the site. However, at that stage, due to timing, it had not been possible to undertake groundwater monitoring.

100. As mentioned above, since our earlier representations, Earlswood Homes have undertaken 12 months of site-specific groundwater monitoring on the land east of Beaumoor Place (January 2021 to January 2022). This site-specific evidence is summarised within the updated Flood Risk Assessment and Outline Drainage Strategy at Appendix C and has been used to develop and outline strategy. As can be seen, the FRA concludes that *"the groundwater flood risk can be mitigated and managed by the proposed development with minimal impact to those on site"* and that *"the development of the site with the proposed drainage system does not pose an unacceptable flood risk either to occupants of the site or to others off the site."*

101. We consider that this site-specific evidence and strategy provides the "confidence" needed to demonstrate the deliverability of a scheme on land east of Beaumoor Place.

102. Furthermore, this evidence should be considered superior to that within the Hydrology Study. This is because, whilst informative, that study makes assumptions about the groundwater conditions on the land east of Beaumoor Place (site F38 in that report), based on monitoring of off-site wells (approximately 190m and 280m from the actual site). Given hydrological conditions can vary over relatively small areas, there are clearly limitations of a broad area study such as this.

103. We therefore request that our updated, site specific evidence is properly reviewed and the Site Assessment Report updated accordingly to reflect that groundwater need not be considered an "absolute" constraint to the development of land east of Beaumoor Place.

Sustainability Appraisal

104. We welcome the fact that our earlier representations which requested that due consideration be given in the SA/SEA to land east of Beaumoor Place as a *'reasonable alternative'* have been heeded. This is reflected in the updated SA/SEA published alongside the consultation.

105. However, we have significant concerns regarding the adequacy and accuracy of this assessment, and fundamentally disagree with some of the conclusions reached. We set these concerns out below following the various topics within the SA.

Topic	Observations
Biodiversity	The finding of a likely adverse effect is unfounded and irrational. The comments in the SA observe that there are no significant biodiversity constraints on site and that there are not likely to be any significant residual effects on protected sites (SAC or SSSI) given the small scale of development. As set out on page iv of the SA, the conclusion of a negative effect hinges solely on a perceived potential impact upon BAP priority habitats, mature trees and hedgerows. However, our Illustrative Sketch Scheme demonstrates how key existing landscape features and boundary vegetation can be retained and provided with a generous open space buffer zone. This open

	space buffer zone can be landscaped to provide promote biodiversity and deliver, as is required by legislation, a minimum 10% net gain in biodiversity. Given there are no identified strategic or "larger than local" ecology impacts and site level biodiversity impacts can be avoided, we believe that a **neutral/no effect** should be concluded.
Climate Change	The SA erroneously identifies the site as being *"located partially within Flood Zone 2 (south of site)"*. This is fundamentally incorrect. A quick review of the latest EA Flood Maps for Planning (as set out within our own Flood Risk Assessment and Outline Drainage Strategy) confirms that all parts of the site are in Flood Zone 1 and therefore at lowest risk of flooding. Furthermore, in view of our own, site-specific groundwater monitoring, we believe that the brief conclusions reached in relation to groundwater within the SA need to be revisited. We consider that, if errors are corrected and due regard given to the up to date site specific evidence, this would justify a **neutral/no effect** in relation to this topic.
Landscape and Historic Environment	We do not disagree with the overall finding in relation to this topic. We welcome the fact that proper regard has been had to the findings of the Heritage Feasibility Study and the observations of the previous Neighbourhood Plan examiner.
Land, Soil and Water Resources	We do not agree that the site falls within best and most versatile agricultural land (Grades 1-3a). We presume this conclusion has been based on the very high level (1:25,000 scale) ALC maps; however, due to the scale of these, they need to be treated with caution. We have reviewed the post-1988 ALC data which is available on MagicMap online, and this helpfully includes assessments for land directly adjacent to the site. Whilst this shows that surrounding land is a mix of Grade 3a and 3b, the land immediately abutting the site to the east was identified as "Other" i.e. not agricultural land. Given land east of Beaumoor Place is surrounded by built development and is itself simply the curtilage of a residential property *Pengerric,* we believe that a proper ALC assessment would similarly conclude that the site is also within the "Other" category (i.e. it is not BMV). In light of the more site-specific evidence available, the SA should conclude a **neutral/no effect** in relation to this topic.
Population and community	We welcome and support the finding of a likely positive effect in relation to this topic.

Health and wellbeing	We welcome and support the finding of a likely positive effect in relation to this topic, including the contribution which additional parking for Fairford Surgery could make to access to healthcare more generally.
Economy and Employment	The findings here are counter-intuitive and we object to this conclusion.

106. Whilst we appreciate that the SA process is not simply a "binary" adding up of plusses and minuses, we believe that – if the SA process were undertaken accurately and fairly for the site – this would confirm that, taken in the round, the development of land east of Beaumoor Place would have an overall positive effect on sustainability of the village and deliver positive benefits under a number of facets. This further supports our view that the site should be allocated, as a small site allocation, alongside the existing proposed allocation (FNP14) between Leafield Road/Hatherop Road.

107. As such, whilst we welcome the fact that land east of Beaumoor Place is now recognised as a reasonable alternative, we remain very concerned about the accuracy, efficacy and consistency of the assessment process. As above, we have identified clear shortcomings and errors within the SA/SEA assessment for the site, which we believe undermine the robustness of the SA and which are fundamental to the evidence base and procedure of the Neighbourhood Plan.

Summary

108. Our representations and supporting evidence robustly demonstrate that the perceived constraints to development on land east of Beaumoor Place, East End which have resulted in its continued omission from the Neighbourhood Plan can be overcome and do not therefore prohibit or preclude development. Matters of detail can be appropriately addressed through the normal development management process and assessment against the policies in the Local Plan and, in time, hopefully an adopted Fairford Neighbourhood Plan.

109. In the terms of the NPPF, it is therefore clear that the site is suitable and available for development, and that such development would be achievable (and financially viable).

110. Given the substantial benefits which development of this site could bring, as acknowledged by the previous Inspector and recognised within aspects of the SA/SEA for the site, we believe that the omission of the site from the Neighbourhood Plan remains erroneous and unjustified. Allocation of Pengerric and land east of Beaumoor Place would support several local objectives and, crucially, would address several deficiencies in the current draft of the plan, thus ensuring that it meets the basic conditions.

111. We once again urge the relevant parties to ensure that the site is properly, accurately, and fairly appraised through SA / SEA as the plan progresses. The current errors within the SA/SEA have clearly had a material impact on the overall conclusions for the site, and must be addressed.

Conclusions

112. Earlswood Homes maintains it full support Fairford Town Council in its preparation of a Neighbourhood Plan and its desires to positively manage growth within its area rather than simply reacting to ad hoc development. This type of local leadership and ownership of planning and growth is welcomed and something which we commend.

113. As before, our representations are made in the spirit of constructiveness, and with a desire to see the Town Council put forward a Neighbourhood Plan that meets the basic conditions required and which ultimately grasps all opportunities to deliver positive change for the town of Fairford and its residents. We are committed to, and wish to maintain, a positive open dialogue with the Town Council and Cotswold District Council to achieve this aim.

114. However, we maintain our **objection** to several key aspects of the plan, and it remains our firm view that – to meet the basic conditions – there are several amendments and changes required and we set out our view on how these can be achieved. These are particularly required to ensure that the plan delivers on local needs and that it is in conformity with national and local policy. Key concerns are:

a. The lack of resilience, robustness, and effectiveness of the strategy for delivering on the housing needs of the village. This stems from the reliance on a single site allocation (FNP14) which, whilst admirable in principle, is subject to many unanswered questions as to its viability and deliverability. These concerns could be addressed by introducing a small number of complementary small site housing allocations to provide flexibility whilst also supporting SME developers in accordance with national policy.
b. A lack of any positive strategy or policy for addressing the housing needs of an ageing population, something which the FNP accepts is a significant local issue and which even forms part of the vision within the Neighbourhood Plan.
c. Issues of non-compliance with national policy in relation to the approach to non-designated heritage assets, transport assessments and sustainable drainage (specifically on sites within areas of groundwater risk).

115. We have demonstrated how further, small allocations – particularly Pengerric and land east of Beaumoor Place, East End – will deliver a series of local benefits which will support the wider aspirations of the Neighbourhood Plan (as acknowledged by the previous Examiner). We remain firmly of the view that the omission of land east of Beaumoor Place from both the Development Boundary and as an allocation site within the FNP is unjustified and is founded on a misguided assessment of both the constraints affecting the site as well as an erroneous SA/SEA. The evidence we have provided (both previously as part of our Regulation 14 representations and again as part of this response – including updated site-specific groundwater monitoring) gives assurance that the constraints identified on this site can be overcome and therefore that they do not render the site unsuitable for development. We repeat our request that due consideration is given to this, and the site included within the plan as an allocation on the basis that we have set out above.

116. We trust the above representations and our supporting evidence are clear and trust that they will assist the Town and District Council as it progresses with the next stages of the Plan. However, we unfortunately reiterate our position that – as things stand – we do not consider that the proposed

submission FNP meets the Basic Conditions in that it does not give due regard to national policy and would fail to contribute to achieving sustainable development. Furthermore, the current failings in the SA/SEA must be addressed.

117. Should you have any questions, please do not hesitate to contact us. Otherwise, please do keep us informed of any further consultations on the Neighbourhood Plan and associated documents, using the contact details below and we would welcome continued dialogue with you.

Yours faithfully

Billy Clements MRTPI
Development Director

Chris Gwilliam
Regional Director

Enc.
Appendix A – Illustrative Sketch Scheme and Design Precedents Study
Appendix B – Heritage Feasibility Study (by Pegasus)
Appendix C – Updated Flood Risk Assessment & Outline Drainage Strategy (by GH Bullard)
[Incorporating site-specific groundwater monitoring data]

APPENDIX F

Groundwater Monitoring and Review of Flood Risk at Fairford Report

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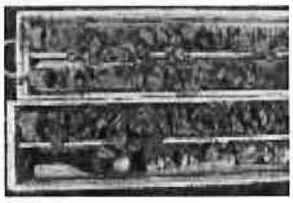
Fairford Town Council

Groundwater Monitoring and Review of Flood Risk at Fairford

Approved Final Report
November 2018



Water Resource Associates

DOCUMENT CONTROL

No of Copies	*Version*	*Date*	*Location/ Comment*
Doc	v1a	27 September 2018	First draft for internal review and addition of Section 5
PDF	v1b	09 October 2018	Draft for client review
PDF	v2	10 October 2018	Edit to section 7
PDF	v3	25 October 2018	Final version addressing comments by FTC
PDF	v4	08 November 2018	Approved final version after further review by FTC

This is Document v4 of the Final report
Signed on behalf of Water Resource Associates:

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MAIN CONTRIBUTORS

This assignment was carried out by:

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Water Resource Associates [WRA] is grateful to **Fairford Town Council**, Fairford Community Centre, High St, Fairford GL7 4AF, represented by **Jon Hill** [Councillor] for the opportunity to carry out this assignment, and support on the ground during the town well inventory and drilling operations.

Cover photographs: Spring in field off Lovers Lane, cable-tool rig drilling borehole B5, A2 core and well-head completion.

DISCLAIMER

Summary

Preamble

Situated in a river basin within the Cotswold Water Park, Fairford has historically suffered many flooding incidents, from overspill from the River Coln but also groundwater, surface water and sewage flooding. Flooding from these other sources has continued since the EA flood alleviation scheme for the River Coln was carried out in 2013, and further investigation was required.

An important part of determining the potential for groundwater emergence or flooding is in understanding the underlying geology and the potential for it to store and transmit groundwater. The geology and hydrology of Fairford is extremely complex; it includes superficial deposits of sands and gravels which may indicate areas more vulnerable to groundwater flooding as a result of prolonged rainfall raising groundwater levels, and also underlying bedrock of much lower permeability, mudstone and limestone which can prevent or reduce infiltration of groundwater from superficial deposits. Fairford also has many springs, where groundwater emerges to the surface, and this gives potential for surface water flooding. There is also a gradient, running roughly NW to SE, which determines the direction of surface water flow. Interaction between these factors increases the potential for flooding. It is likely that groundwater in the superficial layers is recharged by infiltration from rain, runoff and surface water, and also via groundwater from underlying aquifers. This means that when flooding occurs it is slow to subside. It is concluded that SuDS solutions using infiltration are unlikely to be effective in the low-lying areas to the south of the town because of frequent high groundwater levels.

Background

The Fairford Neighbourhood Development Plan [NP] was rejected in 2017 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. The NP 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 was accepted by FTC that the River Coln flood risk has been improved through construction of a new bund and other infrastructure by the Environment Agency in 2013.

Scope and Objectives

The focus of work has been to gain an understanding of groundwater levels so that future development planning can be sited in appropriate places which are not subject to high groundwater levels, so that can infiltration schemes can operate effectively, using CIRIA guidelines to keep maximum groundwater levels at least 1 m below the bottom of soakaways.

Mapping and Geology

Topography

LiDAR data and geological mapping was used to investigate lineaments and micro-relief of the town area which would help in locating monitoring sites and interpreting characteristics of proposed development sites.

Geology

The Fairford town area is underlain successively by Oxford Clay, Kellaways Sand, Kellaways Clay, Cornbrash Limestone and Forest Marble mudstone. The hydrogeology of the Fairford town area is dominated by the interaction between Cornbrash, Terrace deposits, alluvium and the River Coln, and the buried geological boundary between the Cornbrash limestone and Kellaway Clay is located just south of the urban area.

The Cornbrash Formation is part of the Great Oolite Group and consists of intercalated limestone and marl up to 4.5 m thick with local anomalies, and forms a well-dissected gently-sloping landscape with a uniform dip of one degree.

Superficial deposits consist of river alluvium, glacial head deposits in two valleys on the west side of town, then three terrace deposits [old alluvium]: Northmoor, Summertown-Radley and Hanborough. Most of the town area south of London Road and Horcott Road is characterised by up to 5 m of the Northmoor sand and gravels. The Summertown-Radley terrace is confined to higher areas on the west side of along Cirencester Road and south through Burdocks. There are some remnant higher level terraces of little significance for local groundwater.

Water Supply

Until 1946, Fairford used to be supplied by a spring issuing from the Cornbrash, at the junction with Forest Marble under Fairford Old Mill with an average yield of 155 m^3/d [1.8 l/s]. Houses which were not included in this network were dependent on wells 2.7 to 3 m deep in the gravel deposits and Cornbrash across the town.

The supply was then replaced by a Thames Water groundwater supply using boreholes from deeper limestone in the Great Oolite Group, leaving the Cornbrash essentially unexploited in the present-day. Groundwater levels in the Burdocks observation well show the impact of groundwater abstraction.

Groundwater Investigation and Monitoring

New Observation Boreholes

Three boreholes were drilled in the town area to identify lithology, groundwater presence and thickness of gravel and limestone, terminating in the upper part of Forest Marble mudstone.

- A2 on the edge of the Coln House rugby pitch, to investigate the Summertown-Radley terrace deposits; GL 91.4 mOD; 0-2.8 mbgl superficial deposits, 2.8-7.2 mbgl Cornbrash limestone.
- B2 at the end of St Marys Drive, to investigate groundwater conditions in the Cornbrash limestone; GL 91.2 mOD; 0-1.6 mbgl superficial, 1.6-3.7 mbgl Cornbrash limestone.
- B5 at the junction of Lovers Lane and Leafield Road to investigate Cornbrash springs in the field at that point; GL 94.0 mOD; 0-0.7 mbgl superficial, 0.7-3.4 mbgl Cornbrash limestone.

The boreholes were cased and equipped with sensor-loggers and monitored for six months.

Well Inventory

Reconnaissance-inventory was carried out of wells and springs in the area, and five dug-wells dipped monthly. This information was supplemented by historical records obtained from BGS and the Environment Agency for three sites:

- Fairford Cinder Lane.....Oct-2002 to Jun-2018.
- Fairford Burdocks, ...Aug-1996 to Jun-2018.
- Ampney Crucis.....Jul-1993 to Apr-2018 [Dips: Dec-1958 to May-2018]

Groundwater Assessment

Groundwater in the Great Oolite and Borehole A2

There is a national index monitoring site at Ampney Crucis which provides the longest local record of 60 years, free from abstraction influence. This borehole is 61 m deep with groundwater level generally within the Forest Marble, and it recorded the highest groundwater levels in 2014, 1982 and 1965, confirming that the 2018 monitoring at Fairford has not been done under extreme conditions. The overall range in GWL at Ampney Crucis is 6.07 m, while the average range is 3.085 m, typical of the 2017-2018 part of the record. Maximum groundwater levels may be about 1 m higher than average winter levels, if not constrained by local spring discharge.

The 2018 range recorded at A2 in Fairford is 1.74 m [83.2 to 84.94 mOD], and regression analysis was used with caution to extend the A2 record using the Ampney Crucis data, showing that average range in groundwater levels at A2 would be 2.3 m, with a maximum value of 85.9 mOD, and freeboard of 1.4 m below ground level of 87.3 mOD.

Groundwater in Superficial Deposits

The Northmoor terrace outcrops in a broad arc through Horcott and Fairford town south of London Road into the industrial estate and gravel workings. Groundwater levels are monitored by a 4.6m deep borehole at Cinder Lane with a 16-year record. Although groundwater maxima occurred in the winters of 02/03, 06/07, 07/08, 12/13, 13/14, the highest level occurred in July 2007.

The overall range of levels in the Northmoor gravels at Cinder Lane is 2.72 m [78.74 to 81.45 mOD] and ground level is 83.31 mOD. Maximum groundwater levels were simulated for the period 1991-2018, using the available record for the River Coln at Fairford, which showed a T200 freeboard of 1.2 m at Cinder Lane.

Likewise, groundwater levels were simulated for the dug-well records using the Mar-Aug 2018 monitoring period and records at Cinder Lane, Burdocks and Ampney Crucis.

Cornbrash Groundwater

The Cornbrash limestone is relatively thin and although water levels appear to be high during most winters, the formation dewaters during spring-summer, falling to levels controlled by groundwater in the Coln valley. Two wells in the Cornbrash were monitored and Comrie was dry by 17-July despite having over 2 m of water in the well in winter. Likewise, springs at the junction of Lovers Lane and Leafield Road were flowing in winter, but they also dried up over the same period. Boreholes B2 and B5 were drilled to confirm water levels and the thickness of the Cornbrash in this area.

Since Meysey Hampton abstraction was reduced in 2004, the borehole at Burdocks overflows in winter: however, it would appear that the Forest Marble mudstone prevents vertical rise into the Cornbrash.

Maximum Groundwater Levels

Extreme value frequency analysis was carried out at Fairford select sites in order to assess potential groundwater flooding and freeboard with reference to the 1 in 200-yr groundwater level [T200]. This showed that levels would exceed ground level at Riverdale and Comrie. While this is likely to be true of the Northmoor terrace, it is geologically less likely at the higher-level Cornbrash site where groundwater maxima will be depressed by peripheral spring discharge, as with the Ampney Crucis record. It can be concluded however that groundwater levels in the Cornbrash will be close to the surface in T200 conditions.

In contrast, the Summertown terrace analysis shows that groundwater rise is contained with more than a metre of freeboard under T200 conditions.

Implications for Development

Summertown-Radley Terrace

This terrace deposit of 3.0 to 4.4 m thickness and underlying Cornbrash has permanent groundwater and represented by data from A2 and Coln House dug-well. Although groundwater levels are closer to the surface at Coln House dug-well, the area is unlikely to experience groundwater flooding and maximum levels remain well below ground surface.

Part of the F50 site along the southern boundary and south-west boundary will experience high groundwater levels, where the area lies along the boundary with the Northmoor terrace deposits and valley of the Dudgrove Brook. There is scope for infiltration schemes in the northern portion of F50 and area to the north.

Northmoor Terrace

Groundwater in the Northmoor Terrace reflects the regime of the River Coln and this will dominate F44. Although Horcott Road forms local high ground which may impede the entry of floodwater directly from the river, F44 is low-lying [83 to 84 mOD], and river flood level is 84.0 mOD, which suggests that F44 would be vulnerable to groundwater emergence from the alluvial deposits. No area can be considered suitable at this location.

The other Northmoor terrace sites are located east of the river at F15, F38, F39C, F39D and F52. These sites may be represented by data for Cinder Lane and the Keble Fields ground investigation. Cinder Lane showed a freeboard of 1.2 m under T200 conditions, particularly where Northmoor deposits overlie the Cornbrash limestone. This suggests that F15 and F39D satisfy requirements and the development area could be larger, whereas parts of sites F39C and F52 are likely not to have sufficient freeboard. F38 is closer to the monitoring well at Riverdale which showed a risk of groundwater flooding in T200 conditions.

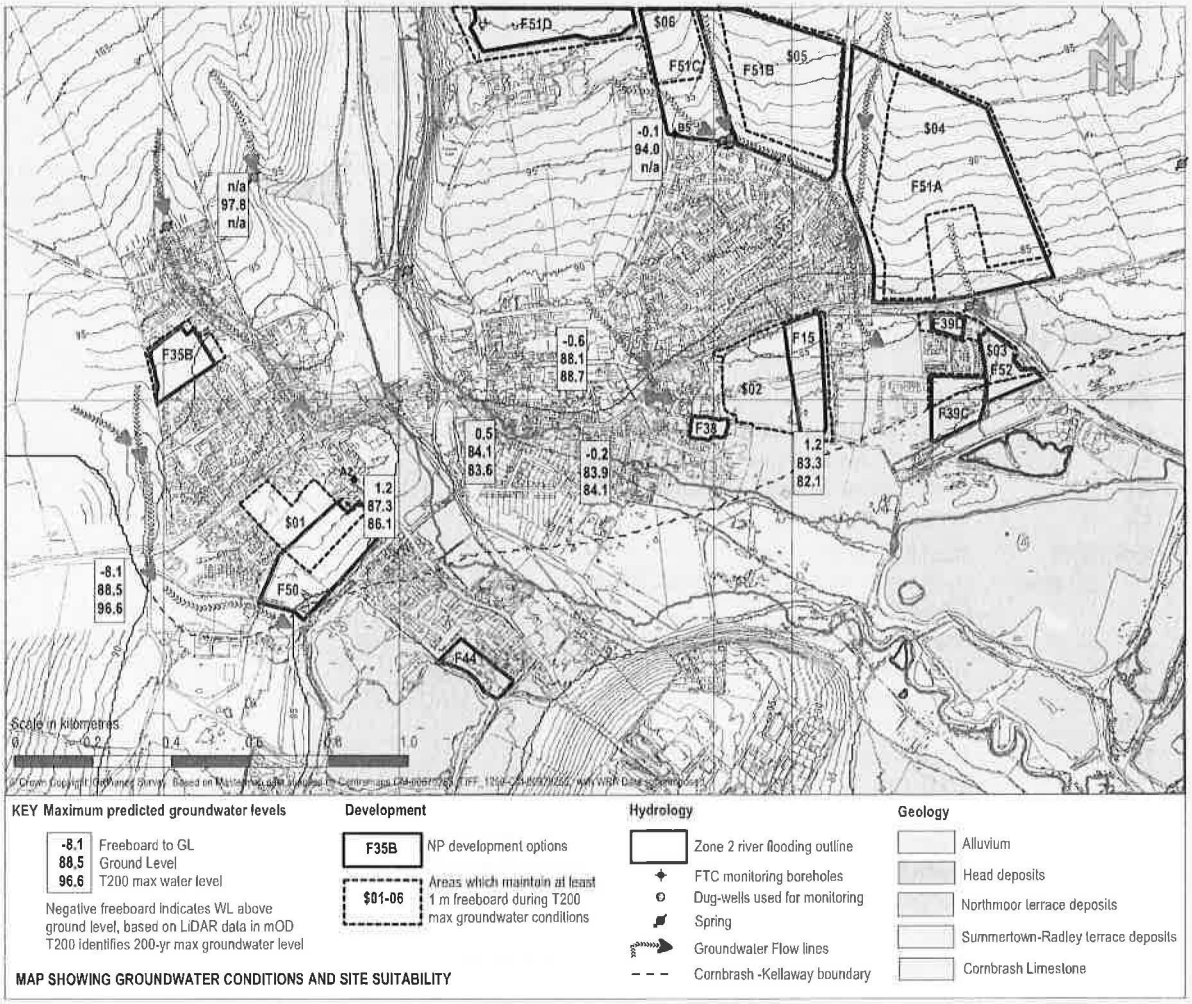
Cornbrash outcrop

In general terms, the Cornbrash outcrop area is characterised by groundwater levels close to the surface during winter which give rise to numerous springs, followed by progressive dewatering of the formation during the spring and summer recession. Evidence of groundwater discharge was confirmed in the shallow valley infilled with head deposits west of Dynevor Place, which follows a route under Milton Farm and into the Coln. The Milton site F35B is distant from this dry valley, so should have reasonable freeboard during times of high groundwater, as confirmed in the dug-well at Dynevor Place.

At the Leafield sites F51A-C, groundwater levels are artesian and close to the surface during winter at several locations, and geological data was provided by boreholes B2 and B5. The low-lying parts of this area do not achieve the desired freeboard, and would be subject to groundwater flooding.

Fairford Park site 51D is at a higher elevation and should achieve the required freeboard. Groundwater flowlines have been drawn to identify areas which would be expected to have higher aquifer permeability and high groundwater levels during flood conditions.

The following figure shows the groundwater conditions and site suitability.



MAP SHOWING GROUNDWATER CONDITIONS AND SITE SUITABILITY

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

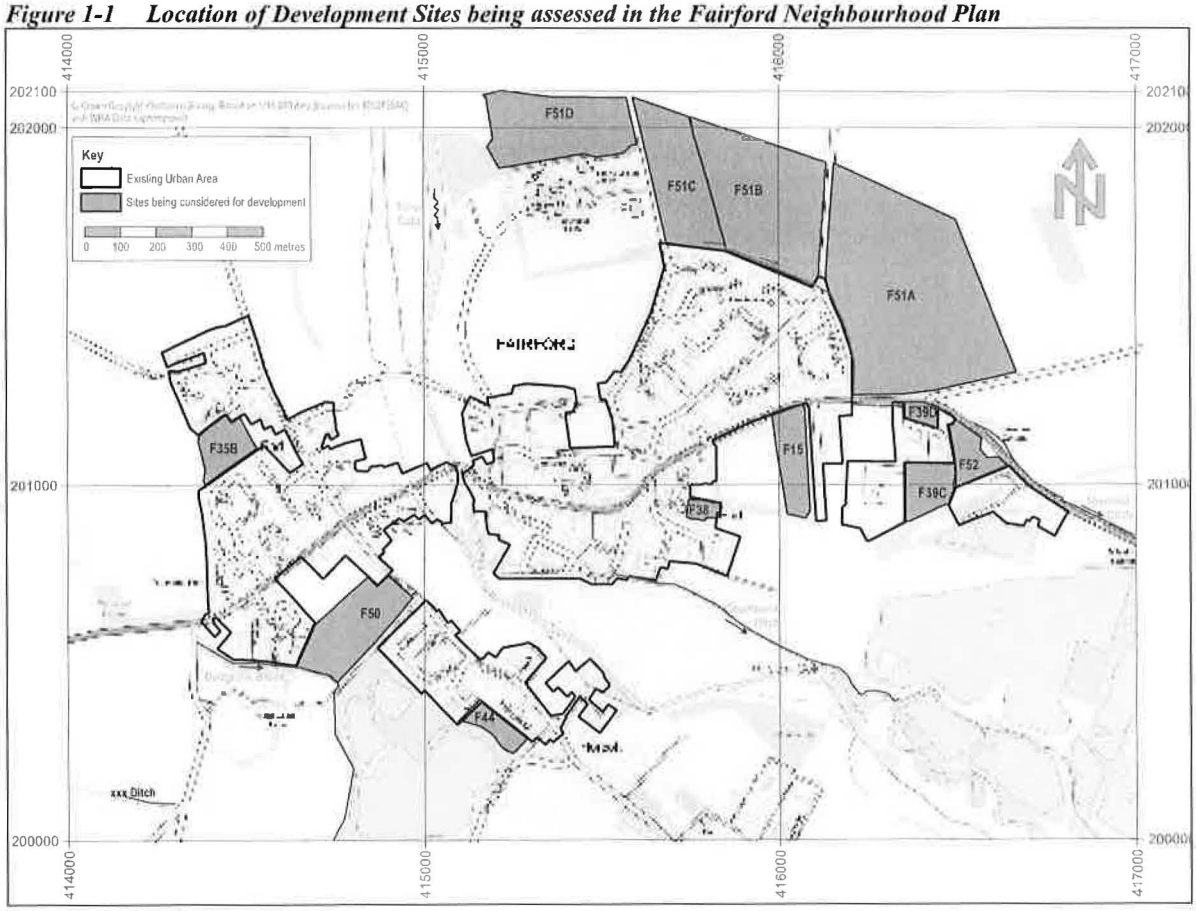
This report has been prepared following the scope of the FTC terms of reference included in Appendix A, taking into consideration a revised outline of sites under assessment.

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.

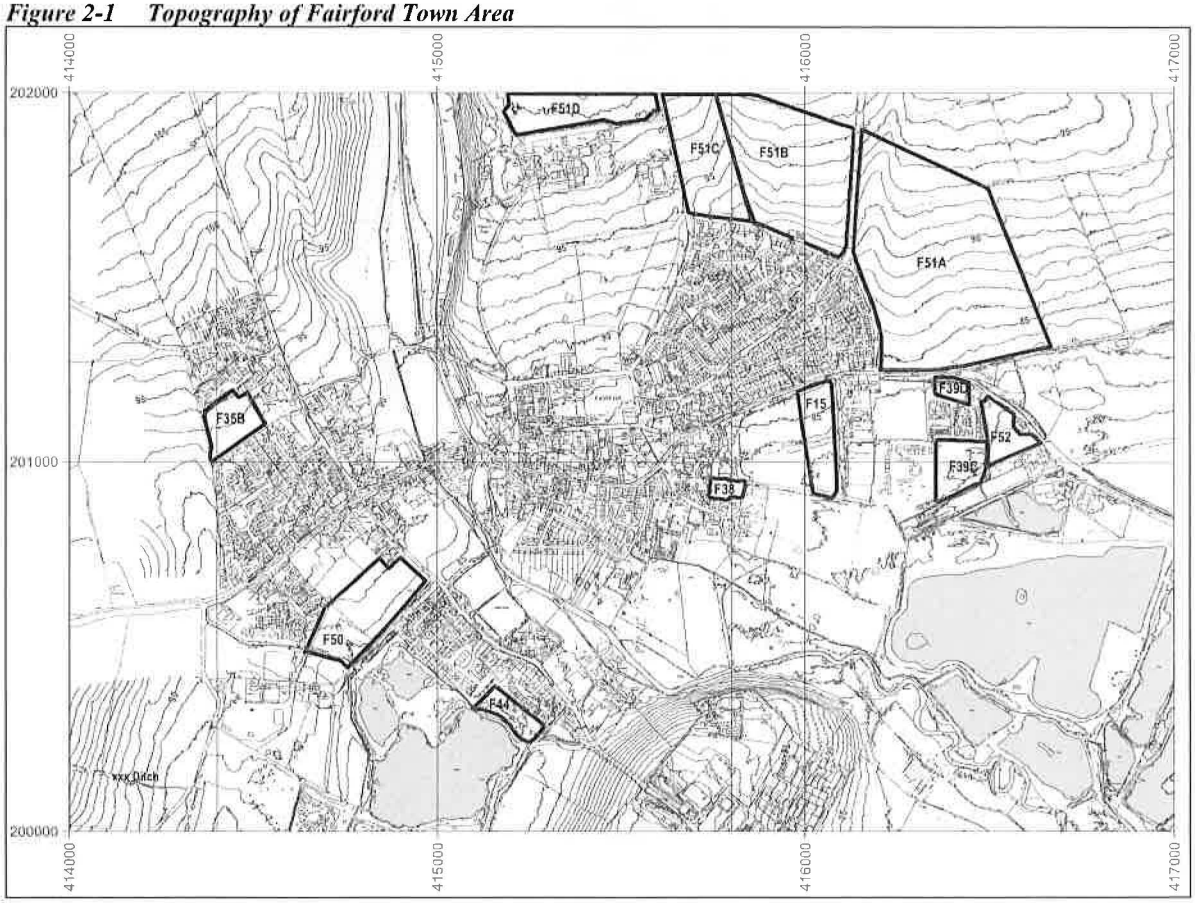
2 Reconnaissance, Mapping and Well Inventory

2-1 Topographic Mapping

Use was made of LiDAR data and geological mapping to investigate lineaments and micro-relief of the town area which would help in locating monitoring sites and characteristics of proposed development sites.

The relevant LiDAR data-tiles were downloaded from the Environment Agency website and processed using GIS software to produce a digital terrain model and contouring for the study area. Together with Ordnance Survey Mastermap data, this topographic information provides a base-map for the investigation and is shown in Figure 2-1, using a 1 m contour interval.

Figure 2-1 Topography of Fairford Town Area



2-2 Rainfall and Recharge

Various types of hydrological data were acquired from the British Geological Survey and Environment Agency with a view to supplementing the local information obtained by observation during the 6-month project monitoring period, Mar-Aug 2018. Location of the monitoring sites is shown in Figure 2-2.

The local data-gathering was put into context using rainfall records from Lechlade [1913-2018], Kempsford [1961-2018], and the Thames model rainfall and infiltration simulation for the Cotswold-West area [1920-2018]. Relevant characteristics are shown in Table 2-1 and listing of all sites is provided in Appendix B-2.

Total winter percolation in the Oct-Mar period, which conditions the start-point of monitoring, totalled 276.1 mm compared with 306.5 mm in an average year and 7.8 mm in a dry winter. Likewise, model rainfall of 420.8 mm is close to the long-term mean of 432.4 mm for the same 6-month period. This confirms that groundwater levels during the 2017-2018 recharge period would be expected to be close to or slightly below-average. Groundwater recession during the period of project monitoring would therefore have provided a

reasonable representation of water level variation. It was only from June onwards that the region suffered a prolonged period of zero or low rainfall which would affect groundwater levels through the summer.

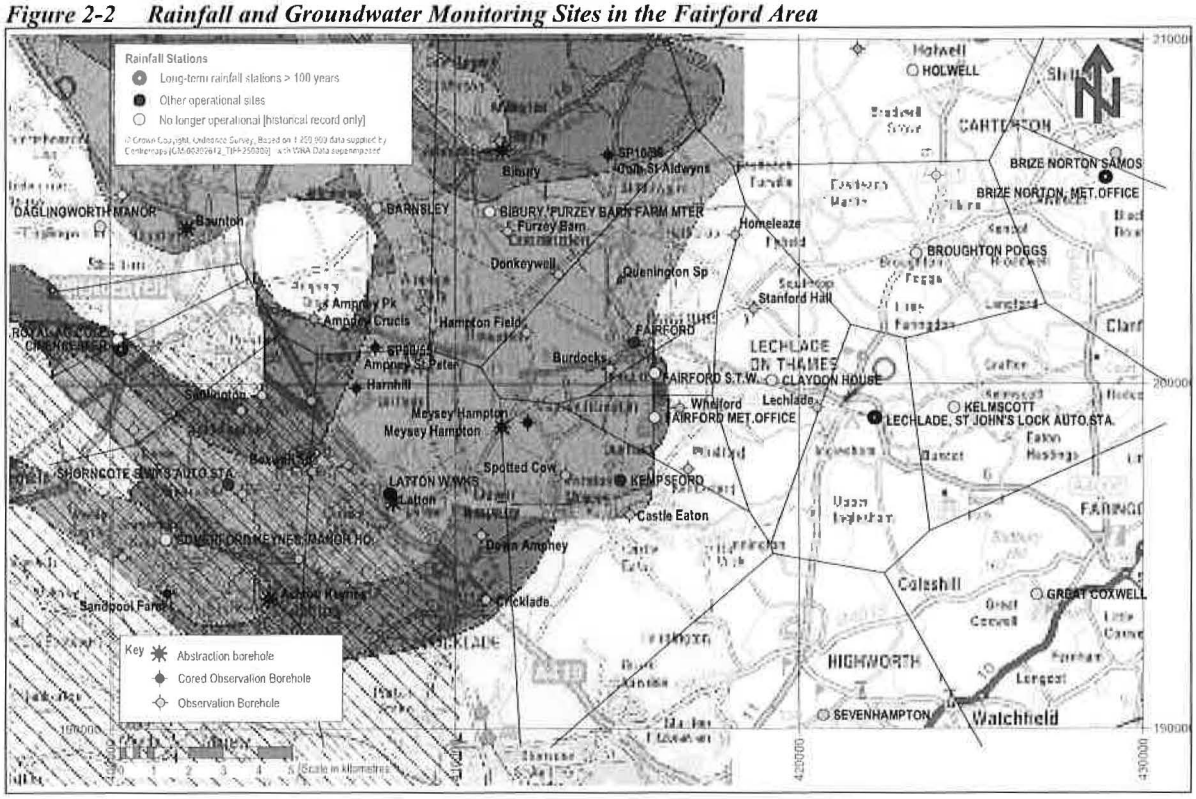
Table 2-1 Rainfall and Infiltration Statistics affecting the Monitoring Period

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Lechlade												
2017	69.1	31.3	40.2	6.5	72.6	29.0	79.6	41.4	47.6	21.9	52.2	97.3	588.7
2018	66.1	25.8	93.5	50.8	62.4								
min	7.2	2.1	3.1	1.0	5.3	5.9	2.7	1.1	6.6	4.4	6.8	11.9	358.6
max	157.1	116.3	158.0	147.3	153.2	151.6	176.1	147.2	142.2	150.3	182.6	130.8	992.4
mean	60.6	44.8	47.4	46.2	55.8	50.0	54.0	60.3	53.2	62.6	64.1	64.9	659.6
	Rainfall for Cotswold West												
2017	75.4	41.0	51.6	11.0	62.7	69.4	74.1	53.7	62.6	33.0	56.1	107.9	698.5
2018	77.5	32.7	113.6	55.6	82.5	2.9							364.8
min	8.3	2.8	2.1	2.5	5.6	2.9	5.6	2.7	4.0	6.7	8.5	13.3	364.8
max	210.0	164.4	168.0	171.3	181.5	159.1	201.4	161.7	162.1	163.9	215.6	200.8	1157.5
mean	79.5	56.6	56.6	55.7	65.3	57.3	62.7	70.2	67.1	75.4	82.4	82.0	806.3
	Areal Infiltration for Cotswold West												
2017	69.4	28.2	27.6	0.5	5.2	5.7	6.7	3.0	5.5	3.6	7.8	92.7	255.9
2018	72.0	24.9	75.1	20.0	8.8	0.0							200.8
min	3.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	2.8	1.8	101.6
max	202.9	146.3	148.0	101.6	106.3	49.7	109.3	58.1	109.1	139.4	180.5	188.9	679.3
mean	72.6	45.7	30.5	16.4	10.1	7.3	7.3	8.2	14.7	26.8	59.1	71.9	368.6

Note: The Cotswold-West model cell is referenced as 6010 in EA Thames Region water resources situation reports and data-sets.

Key: Winter recharge period Project monitoring period

Figure 2-2 Rainfall and Groundwater Monitoring Sites in the Fairford Area



Groundwater source protection zones shown by colour shading: 1 red, 2 green, 3 blue.
[Ampney Crucis and Whelford unaffected by abstraction]

2-3 Geology of the Fairford Town Area

2-3-1 Mapping and Formations

The solid geology of the Fairford town area consists of the following units:

- Oxford Clay Formation - mudstone.
- Kellaways Sand Member - sandstone and siltstone, interbedded.
- Kellaways Clay Member - mudstone.
- Cornbrash Limestone.
- Forest Marble Formation predominantly mudstone, greenish grey, variably calcareous and intercalated with sandy cross-bedded limestone lower in the sequence.

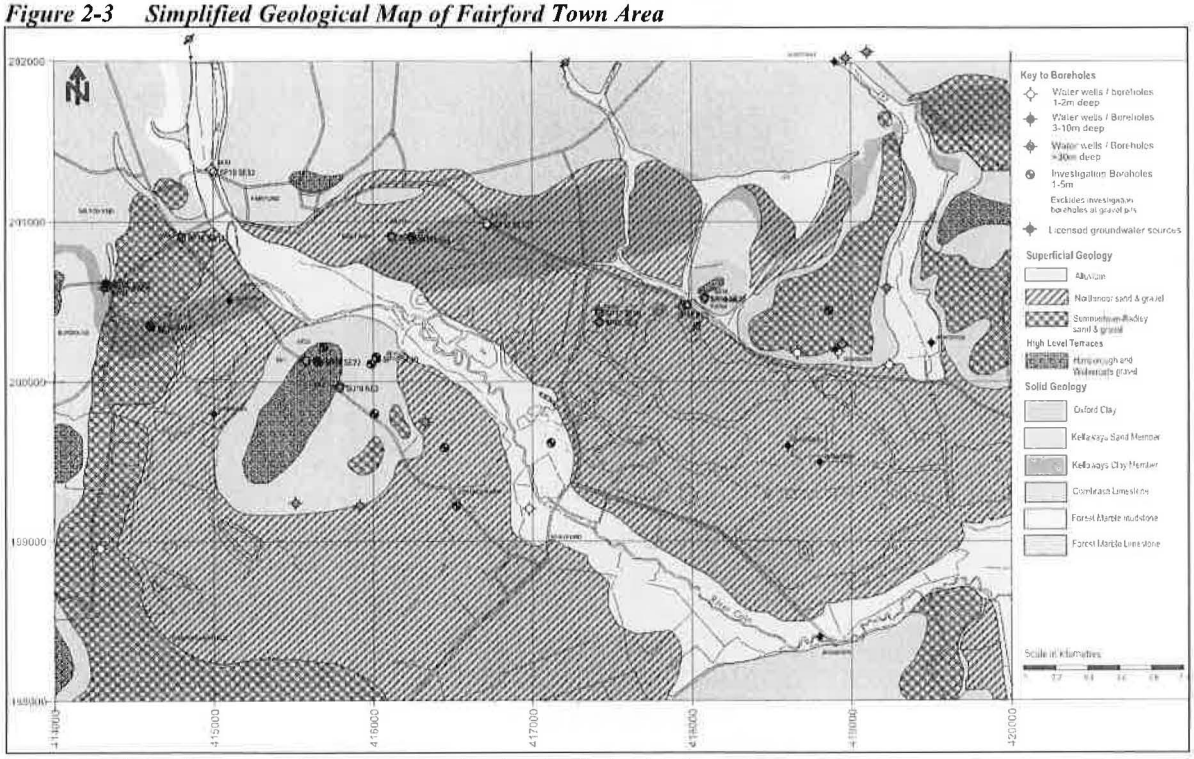
The hydrogeology of the Fairford town area is dominated by the Cornbrash Formation and the interaction of river and groundwater level in the various sand and gravel deposits. The geological boundary between the Cornbrash limestones and Kellaway Clay Formation is located just south of town, roughly travelling south where the sand and gravel deposits begin. The outcrop of different geologies is shown in Figure 2-3.

The Cornbrash Formation is part of the Great Oolite Group and consists of a complex sequence of limestones interbedded with marls and well-known for local anomalies which do not conform to the usual succession. The outcrop forms a well-dissected gently-sloping landscape with a fairly uniform dip of one degree.

The limestones found through drilling at Fairford are pale grey to ochreous brown, argillaceous and sandy, containing fine-grained shell debris. The drill cuttings were typically a coarse brown sand mixed with ochreous silty-clay.

It is reported that the thickness of the Cornbrash is 3 to 4.5 m. In a borehole at Meysey Hampton, the thickness is 4.4 m, and a distinction is made between a sandier upper layer and lower fine limestone layer, but the difference may not be apparent in terms of lithology at some locations. The georeference section is located at Shipton-on-Cherwell Cement Works Quarry, 4.4 km north-northwest of Kidlington, Oxfordshire, where there is a complete sequence exposed, up to about 3 m thick.

Figure 2-3 Simplified Geological Map of Fairford Town Area



Based on OS 1:50,000 scale raster base-map and simplification of geological data from various sources

The BGS lexicon of named rock units describes the lithology of the Cornbrash Formation as follows:

"Limestone, medium- to fine-grained, predominantly bioclastic wackestone and packstone with sporadic peloids; generally and characteristically intensely bioturbated and consequently poorly bedded, although better bedded, commonly somewhat arenaceous units occur in places, particularly in the upper part. Generally bluish grey when fresh, but weathers to olive or yellowish brown. Thin argillaceous partings or interbeds of calcareous mudstone may occur".

The lower boundary is generally a sharp, disconformable non-sequence, where bioclastic limestone rests on mudstone of the Forest Marble Formation.

The superficial deposits of the Fairford town area consists of the following units:

- Alluvial deposits of clay, silt, sand and gravel form a corridor along the River Coln valley.
- Head deposits of clay, silt, sand and gravel formed in a periglacial environment fill shallow valleys on the west side of town.

These are followed in age by the following Thames river terrace deposits:

- Northmoor Sand and Gravel Member
- Summertown-Radley Sand and Gravel Member
- Hanborough Gravel Member

Most of the town area south of London Road and Horcott Road is characterised by up to 5 m of the Northmoor sand and gravels and this is the lowest of the terrace deposits. The Summertown-Radley terrace is confined to higher areas on the west side of town north and south of Cirencester Road and in the Burdocks area.

There are some remnant higher level terraces of the Hanborough and Wolvercote group on the top of Horcott and at the junction of Leafield Road and Park Street. These have little consequence for local groundwater.

2-3-2 Local Information

Information on lithology was obtained from the BGS archive, and some of the data from old boreholes in the area are summarised in Table 2-1. This provided a number of useful references, in particular the borehole logs for the Retreat [now Coln House School], Cinder Lane and Burdocks, and further details are provided in Appendix E.

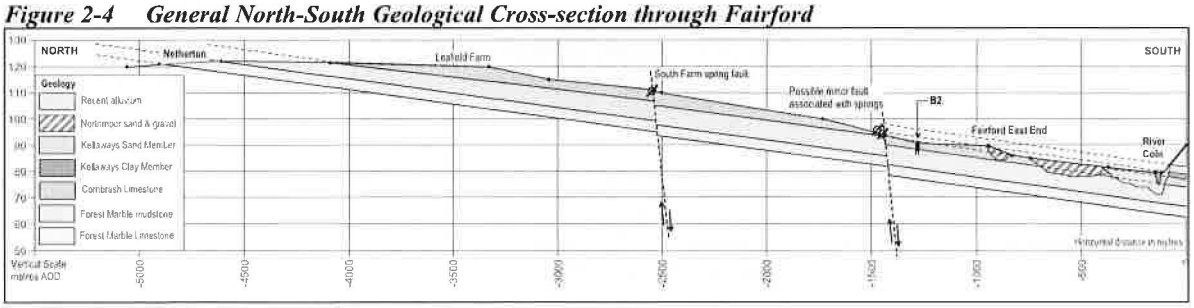
Table 2-2 List of Historical Wells and Boreholes in the Fairford Area

Site name	Easting	Northing	Depth m	BGS Ref	GL m aMSL	Cons Date	Terr-ace	Kell-away	Cb	FM clay	FML l/st	White L/st	RWL mbgl
The Retreat Fairford	414800	200900	35.66	SP10 SW13	86.8	1924	1.5	n/a	0.0-2.1	2.1-6.4	6.4-13.1	-	2.13
Fairford Football club	416119	200903	4.70	SP10 SE114			4.7	-	-	-	-	-	2.36
Beaumoor Farm	416250	200890	4.00	SP10 SE4				4.9	-	-	-	-	
EA Burdocks geophysical log	414340	200610	79.00	SP10 SW22	88.95	1982			0.0-6.5	6.5-14.5	14.5-36.5	36.5-48.0	3.30
EA Burdocks Obs BH	414330	200590	79.00	SP10 SW34	89.45	1982			0.0-6.5	6.5-14.5	14.5-36.5	36.5-58.0	3.30
Fairford old mill	415000	201310	**-2.00**	SP10 SE53					spring				
Burdocks [Summertown]	414610	200340	4.60	SP10 SW4	88.7	1971	0.2-4.1	4.1-4.5	4.5-	-	-	-	
Fairford : New Chapel Electronics	416720	200980	3.96	SP10 SE107		1984	0.0-3.96	-	-	-	-	-	

Key: Cb Cornbrash, FM Forest Marble, FML Forest Marble limestone, l/st Limestone, RWL Rest water level, GL Ground level

A North-South geological section from Quenington across Fairford Park through Fairford town to Horcott has been interpreted in Figure 2-4. This exemplifies the thin nature of the Cornbrash Limestone and the fact that the thickness is expected to be fairly similar across the area due to the slope and dip.

Figure 2-4 General North-South Geological Cross-section through Fairford



Note. Line of cross-section shown in Appendix Figure C-1.

2-4 Historical Use of Groundwater for Supply

Part of the parish of Fairford used to be supplied by an undertaking belonging to R Barker of Fairford Park. The source of supply was a spring issuing from the Cornbrash, where it is thrown out by the Forest Marble under Fairford Old Mill. The water was piped to reservoirs and tanks at Milton End 150 m^3/d, 91 m^3/d, Manor Farm 6 m^3/d, Fairford Park 18 m^3/d, Farhill Farm 5 m^3/d and Leafield Farm 5 m^3/d. The daily average quantity of water supplied by the spring was 155 m^3/d [1.8 l/s]. Houses which were not included in this network supply were dependent on wells in the gravel deposits and Cornbrash across the town. In the centre of Fairford, these were reported to be 2.7 to 3 m deep and the water level reflecting changes in discharge in the River Coln [Wells and springs of Gloucestershire, p92].

On the side of Waitenhill, where gravel rests on Oxford Clay, a spring used to be exploited and the water pumped into a 10 m^3 tank from where it gravitated to Burdocks and two lodges. A second spring at the locality supplied Waitenhill Farm buildings and did not fail until the drought of 1921.

Another spring was reported issuing from the Cornbrash near Barrow Elm Farm and there were numerous wells in the Cornbrash dotted about the fields. The Fairford Mill spring was used until approximately 1946. These have all been replaced by a new Thames Water groundwater supply using boreholes from deeper limestone in the Great Oolite Group, leaving the Cornbrash essentially unexploited in the present-day. Groundwater levels can therefore be expected to be at natural rest levels, except on the west side of town where groundwater abstraction will have an impact on groundwater levels beneath the Forest Marble.

3 Groundwater Monitoring

3-1 New Observation Boreholes

Three small diameter boreholes [150 to 200 mm] were drilled within the town area of Fairford to identify lithology, determine groundwater occurrence and formation thickness of the Cornbrash limestone and Summertown sand and gravel deposits. Drilling at all sites aimed to terminate after penetrating the upper part of Forest Marble mudstone.

Various options were evaluated, identified as A1-3, B1-5 and C1-3. The finally selected sites were:

- Site A2 located on the western edge of the Coln House School rugby pitch field [owned by GCC Education Department] north of the Horcott Road gate, to establish groundwater levels in the Summertown-Radley Sand and Gravel terrace deposits.
- Site B2 located at the end of St Marys Drive, to establish groundwater conditions in the Cornbrash limestone.
- Site B5 located on the north-eastern edge of town at the junction of Lovers Lane and Leafield Road to establish groundwater conditions up-gradient from springs in the cropped field at that point.

Sites A2 and B2 were drilled using Fraste and Comacchio rotary drilling rigs and site B5 was drilled using a Pilcon Wayfarer lightweight cable-tool percussion rig, at a drill diameter of 150 mm.

The succession at each site has been summarised in Table 3-1.

Table 3-1 Summary of Lithology in Project Boreholes A2, B2 and B5

A2: GL 91.4 mOD		**B2:** GL 91.2 mOD		**B5:** GL 94.0 mOD	
Depth m	**Lithology**	**Depth m**	**Lithology**	**Depth m**	**Lithology**
0.00-1.10	Clayey sand and gravel	0.00-0.90	Made ground	0.00-0.35	Made ground, lumps of limestone and clayey earth
2.50-2.80	Coarse limestone gravel and cobbles	0.90-1.60	Gravelly clay and limestone	0.35-0.70	Brown-Dark brown gritty-sandy clay with limestone cobbles
2.80-7.15	Cornbrash Limestone	1.60-3.70	Cornbrash limestone [orange brown sandy limestone	0.70-3.40	Cornbrash limestone [very hard ochreous brown sandy limestone with shells]
7.15-8.20	Forest Marble mudstone	3.70-6.00	Forest Marble mudstone [grey silty clay	3.40-4.10	Forest Marble mudstone [stiff blue-grey clay]

Two of the boreholes, A2 and B5, were completed with casing, screen, filter pack, bentonite, concrete well-head block and steel access plate, for monitoring during the project and into the future. The sites were then equipped with a Troll-100 groundwater level sensor and data-logger, housed inside the borehole and the well-head secured using bolts which can easily be opened with the appropriate spanner for monitoring activities.

3-2 Well and Borehole Inventory

Reconnaissance and inventory were carried out of wells and springs in the project area with the help of FTC, and arrangements made with owners to carry out monthly dipping at selected sites. In all, nine old dug-wells were identified, summarised in Table 3-1, of which five were selected for monitoring of the seasonal variation in groundwater levels in different geological formations. Further details of the wells are provided in Appendix B-1.

This information has been supplemented by the project boreholes and historical records obtained from the BGS and the Environment Agency for observation boreholes monitored in the area. These boreholes are summarised in Table 3-2.

Table 3-2 Fairford Town Dug-Well Inventory

Ref	Address	Owner / contact	Easting	Northing	GL	WellTop	Depth	Dia	Stick-up
					mAOD	mAOD	m bWT	mm	WT-GLm
1	Riverdale, London Road	Kevin Wigham	415557	200928	83.90	83.90	1.90	700	0.00
2	2 Eastbourne Terrace	Jason Baker	415518	200924	83.90	83.90	-	-	0.00
3	Colosseo Restaurant, London Rd	Sous Guenaoua	415223	200970	83.65	84.40	2.85	-	0.75
4	Comrie [Dovecote House]	Mr&Mrs deCourcy-Ireland	415387	201183	86.20	86.75	4.32	780	0.55
5	Moor Farm	Margaret Bishop	415870	200855	83.00	83.00	1.34	-	0.00
6	Well House, 2 Coronation Street	n/a	414756	200928	88.00	88.00	-	-	0.00
7	Coln Ho Reform School -front yard	GCC	414767	200910	87.00	87.00	4.33	800	0.00
8	Thornhill Farm	New owner	418080	200520	80.30	80.30	8.84	950	0.00
9	2 Dynevor Place	n/a	414523	201417	97.60	97.60	2.10	450	0.00

Table 3-3 Summary of Project and National Observation Boreholes in the Area

Ref	Address	Owner / contact	Easting	Northing	GL	WellTop	Depth	Dia	Stick-up
					mAOD	mAOD	m bWT	mm	WT-GLm
A2	Project Borehole A2	FTC	414911	200812	87.30	87.30	6.70	50	0.00
B5	Project Borehole B5	FTC	415704	201675	94.00	94.00	4.10	50	0.00
SP10/105	Fairford Football Club, Cinder Lane	Environment Agency	416118	200900	83.31	83.95	4.60	200	0.64
SP10/085	Fairford Burdocks	Environment Agency	414325	200605	88.50	89.1	-	-	-
SP00/062	Ampney Crucis	BGS Nat Index site	405900	201900	-	-	-	-	-
SP10/004	Donkeywell Buildings	Environment Agency	412777	203420	121.0	121.6	-	-	-

A mixture of daily and weekly groundwater levels was acquired as follows:

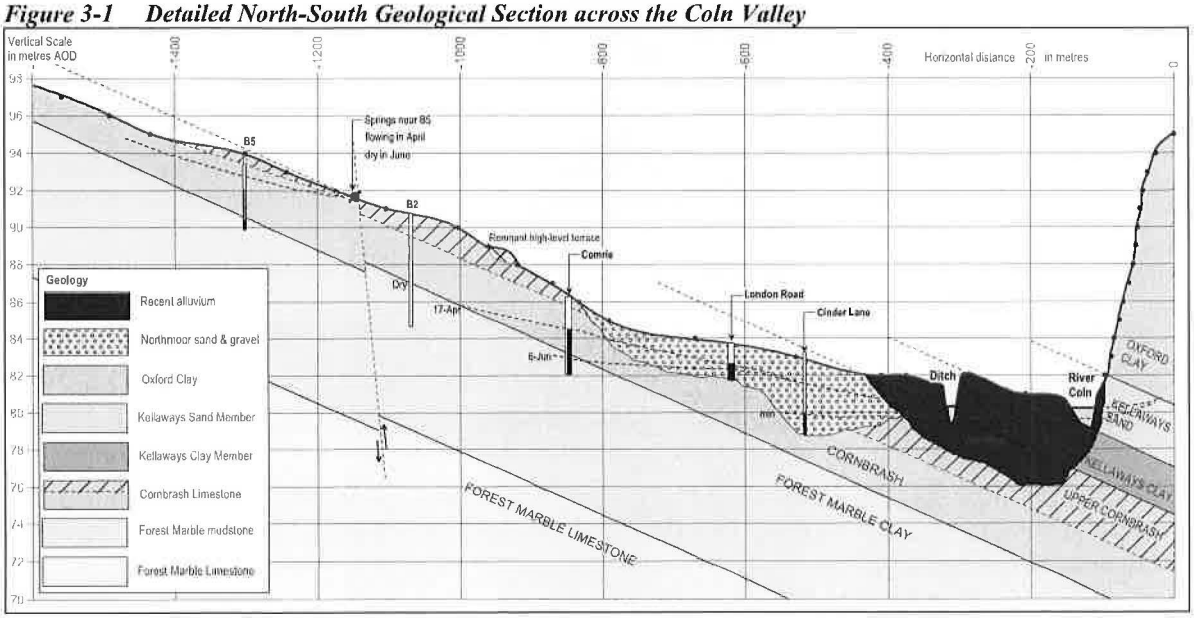
- Fairford Cinder Lane.....Oct-2002 to Jun-2018.
- Fairford Burdocks.....aug-1996 to Jun-2018.
- Ampney Crucis.....Jul-1993 to Apr-2018. Dips: Dec-1958 to May-2018.

The project borehole loggers were set at 3-hourly data interval.

3-3 Interpretation of Town Geology

The knowledge of local geology, BGS mapping and information from drilling and monitoring has allowed the interpretation of a detailed cross-section across the town area as shown in Figure 3-1. A similar cross-section has been drawn on the west side of the Coln Valley.

Figure 3-1 Detailed North-South Geological Section across the Coln Valley



Note: Exaggerated vertical scale for a strata dip of 1 degree.
Line of cross-section and detailed mapping shown in Appendix Figure C-1.

3-4 Groundwater Level Monitoring

The drilling of A2 and B2 was completed in March 2018 and borehole B5 in August 2018, giving a 6-month record at A2. Monitoring involved monthly dipping and download of the data-loggers with corrections made for barometric pressure and sensor drift relative to dipped values. The groundwater recession hydrograph is shown n Figure 3-2.

The dug-well hydrographs are shown n Figure 3-2 for the same period.

Figure 3-2 Variation in Groundwater Level in Borehole A2, Mar-Aug 2018

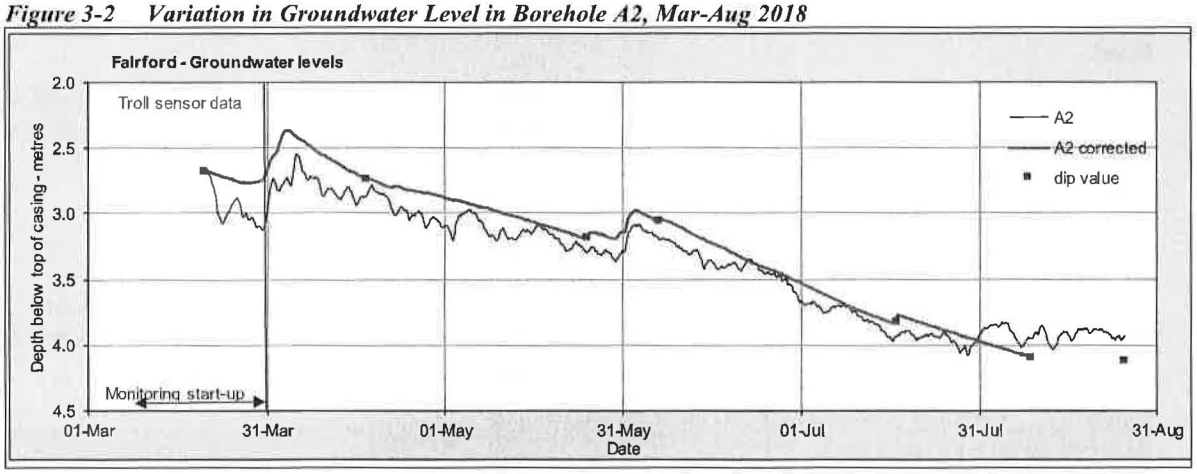
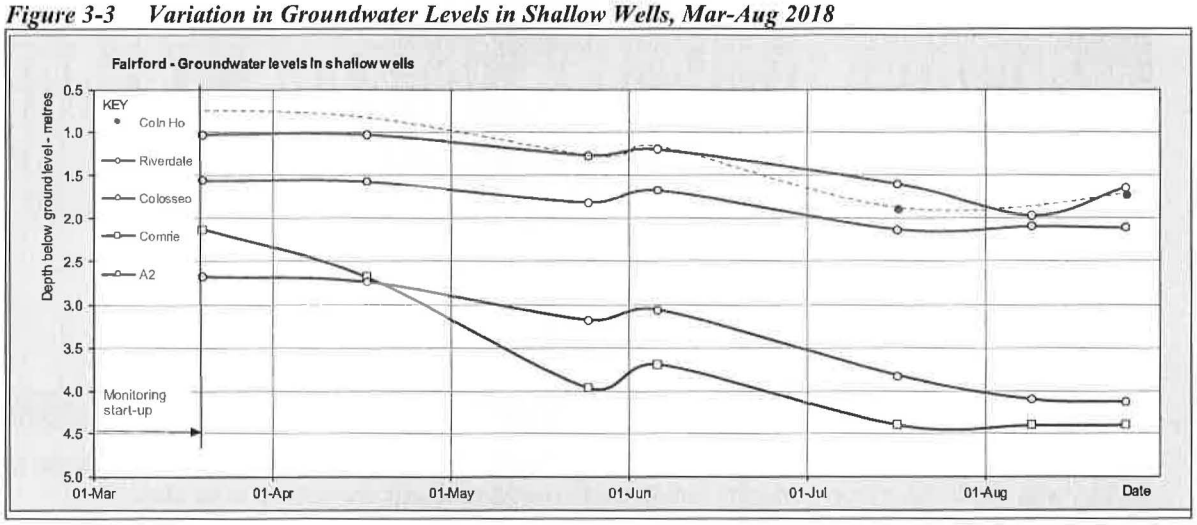


Figure 3-3 Variation in Groundwater Levels in Shallow Wells, Mar-Aug 2018



It was found that springs rise in the fields adjacent to site B2 at a distance of 75m, so groundwater level comes to the surface at that location.

4 Groundwater Assessment

4-1 Scope

The focus of the WRA assignment has been to gain an understanding of groundwater levels in Fairford, so that future development planning can be sited in appropriate places which are not subject to high groundwater levels where SuDS schemes can operate effectively. These results will then help FTC in the preparation of the Neighbourhood Plan.

The client has specifically asked for a "comparative risks assessment" for sites off Horcott Road and Leafield Road.

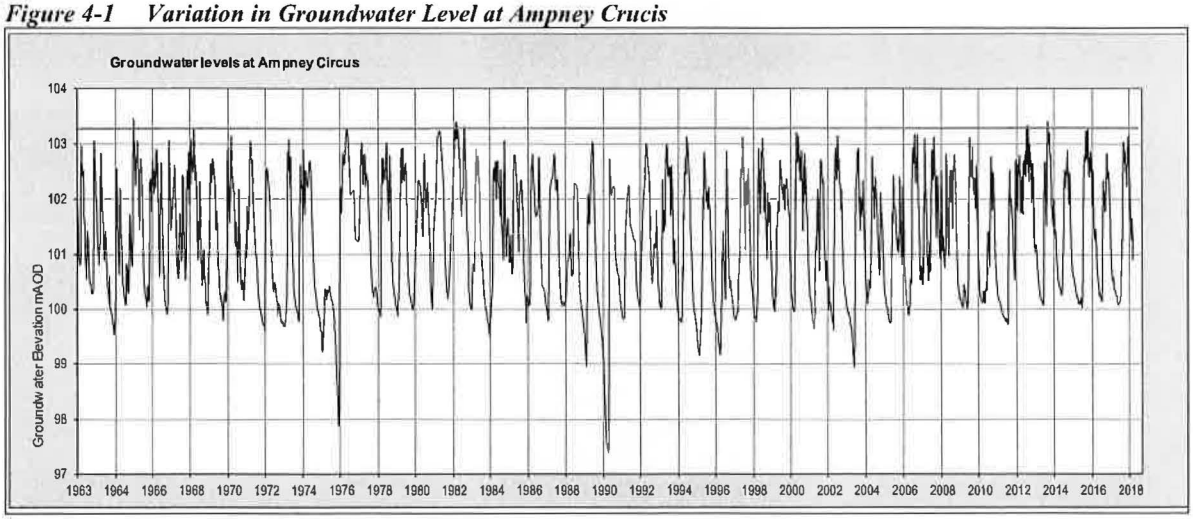
This section looks at the results of the groundwater monitoring and reviews available hydrological data, examining the correlation of short-term records with long-term groundwater records in order to predict seasonal fluctuation and the range in groundwater levels at the sites of interest.

4-2 Long-term Records

4-2-1 Groundwater Level in the Great Oolite

Groundwater Level in the Great Oolite at Ampney Crucis [SP00/62] is monitored by EA Thames as a national index site, and it provides the longest local record of 60 years, beginning in 1959, which is free from abstraction influence. The hydrograph is shown in Figure 4-1.

Figure 4-1 Variation in Groundwater Level at Ampney Crucis



This borehole is 61 m deep penetrating into Fuller's Earth, and measures groundwater level in the Great Oolite, with a rest water level generally within the Forest Marble, and considered to be unconfined.

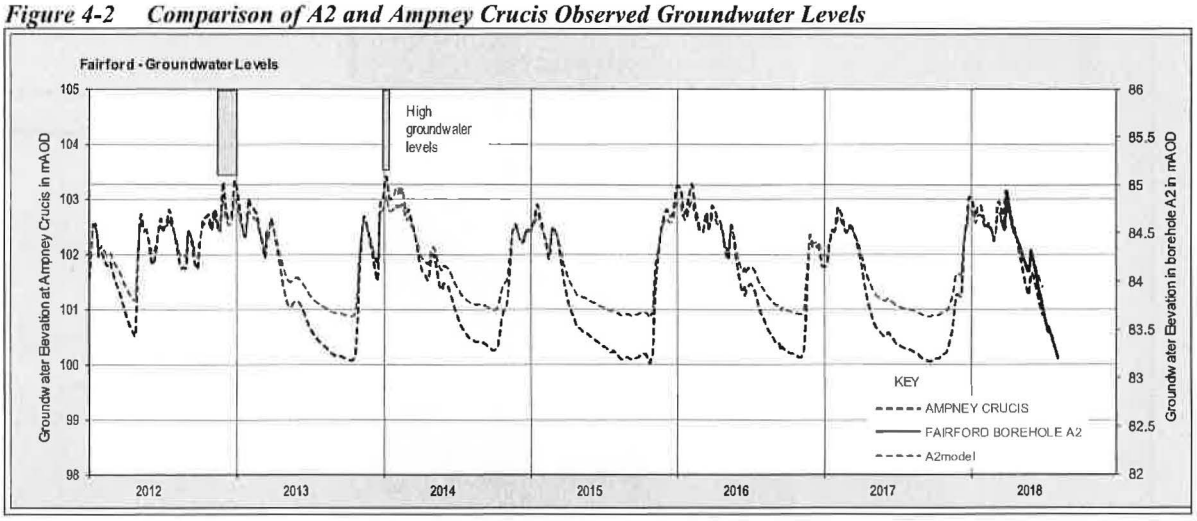
The 12 highest groundwater levels have been summarised in Table 4-2, using a threshold value of 103.2, identifying three years [2014, 1982, 1965] with particularly high levels which may have triggered groundwater flood events. Although top of borehole is 109.52 mOD, maximum values do not greatly exceed 103 mOD due to local springs.

This confirms that the recent phase of monitoring has been done following a period of average winter recharge and should serve as a reasonable indicator of the seasonal change in levels. The most recent part of the Ampney Crucis record has been used to compare the response in Fairford local wells monitored during 2018. The A2 record is plotted in Figure 4-2. The short record of groundwater levels from new monitoring wells will help the process of extrapolation of the seasonal range from existing monitoring sites.

Table 4-1 Years with Highest Groundwater Level [GWL] in mOD at Ampney Crucis

Date	GWL		Date	GWL		Date	GWL		Date	GWL
10/02/2016	103.26		10/01/2007	103.16		**12/12/1982**	**103.38**		09/02/1969	103.27
08/01/2014	**103.40**		06/11/2000	103.20		03/02/1982	103.19		**19/12/1965**	**103.45**
27/12/2012	103.32		08/05/1983	103.30		10/03/1977	103.26		29/01/1960	103.28

Figure 4-2 Comparison of A2 and Ampney Crucis Observed Groundwater Levels

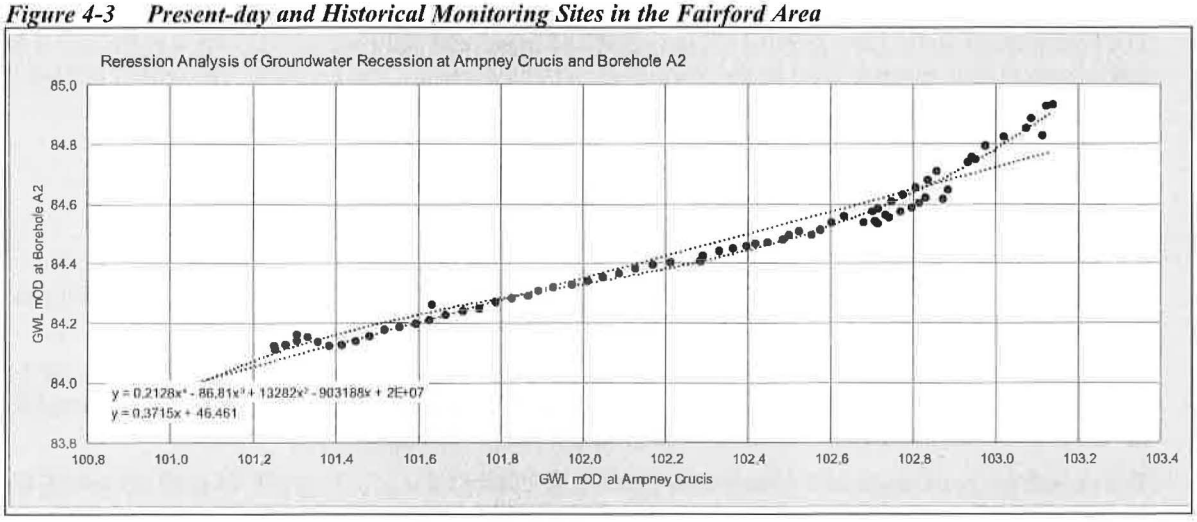


The overall range in GWL at Ampney Crucis is 6.07 m [97.38 to 103.45 mOD], while the average range is 3.085 m [100.05 to 103.135 mOD], typical of the 2017-2018 part of the record. Maximum groundwater levels may be about 1 m higher than average winter levels, if not constrained by local spring discharge.

The range recorded at A2 in Fairford is 1.74 m [83.2 to 84.94 mOD].

The simple regression analysis shown in Figure 4-3 may be used with caution to extend the water level record using the Ampney Crucis data. Using this equation, the average range in groundwater levels at borehole A2 would be of the order of 2.3 m while a maximum value might be 85.9 mOD, which leaves a freeboard of 1.4 m below ground level of 87.3 mOD. The A2 modelled time series is superimposed on observed data in Figure 4-2, showing that a reasonable representation of maximum water levels can be obtained.

Figure 4-3 Present-day and Historical Monitoring Sites in the Fairford Area

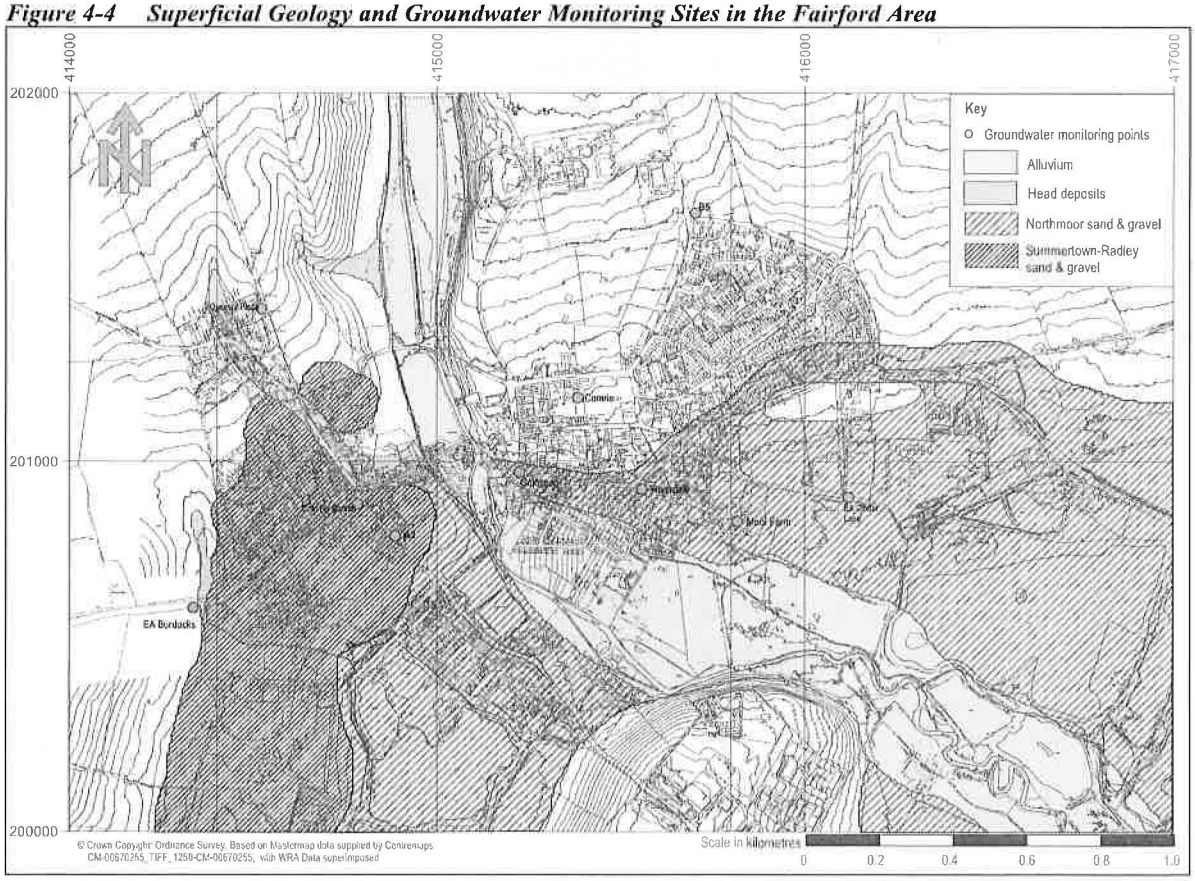


4-2-2 Groundwater Level in Superficial Deposits

There are three main belts of superficial deposit which will be characterised by different groundwater regimes. The alluvial deposits along the River Coln valley will be directly linked to changes in river level, so that, broadly speaking, temporal change in levels in the alluvium will follow river level with a slight delay.

Then there are two terrace deposits: the Northmoor sand and gravel is the lowest level terrace in the area and outcrops in a broad belt through Horcott village and Fairford town south of London Road and through the industrial estate. Groundwater levels in the Northmoor terrace are monitored by the Environment Agency in the Cinder Lane borehole and this has a 16-year record, 2002-2018. The geology and monitoring sites are shown in Figure 4-4.

Figure 4-4 Superficial Geology and Groundwater Monitoring Sites in the Fairford Area



The borehole at Cinder Lane [SP10-105] only partially penetrates sand and gravel with a depth of 4.6 m bgl and measures groundwater level in the Northmoor terrace deposits. The borehole was drilled in May 2002 and lithology was recorded as follows:

- 0.00 – 0.10 m bgl Top soil
- 0.10 – 0.40 m bgl Brown clay
- 0.40 – 1.90 m bgl Sandy gravel and clay
- 1.90 – 4.70 m bgl Coarse gravel and sand

Ground level at SP10-105 is 83.31 mOD and the well sticks up to a level of 83.95 mOD. A limestone boulder was found at a depth of 4 m during drilling, and rest water level after drilling was 80.95 mOD.

The highest groundwater levels have been summarised in Table 4-3, using a threshold value of 81.15, identifying five winter periods [02/03, 06/07, 07/08, 12/13, 13/14,] with higher-than-average groundwater levels. In addition, there were unusually high groundwater levels in July 2007.

The overall range of levels in the Northmoor gravels at Cinder Lane is 2.72 m [78.74 to 81.45 mOD] for the period 2001-2018, which demonstrates that groundwater has never reached ground level at this location.

Table 4-2 Highest Groundwater Level [GWL] in mOD at Cinder Lane

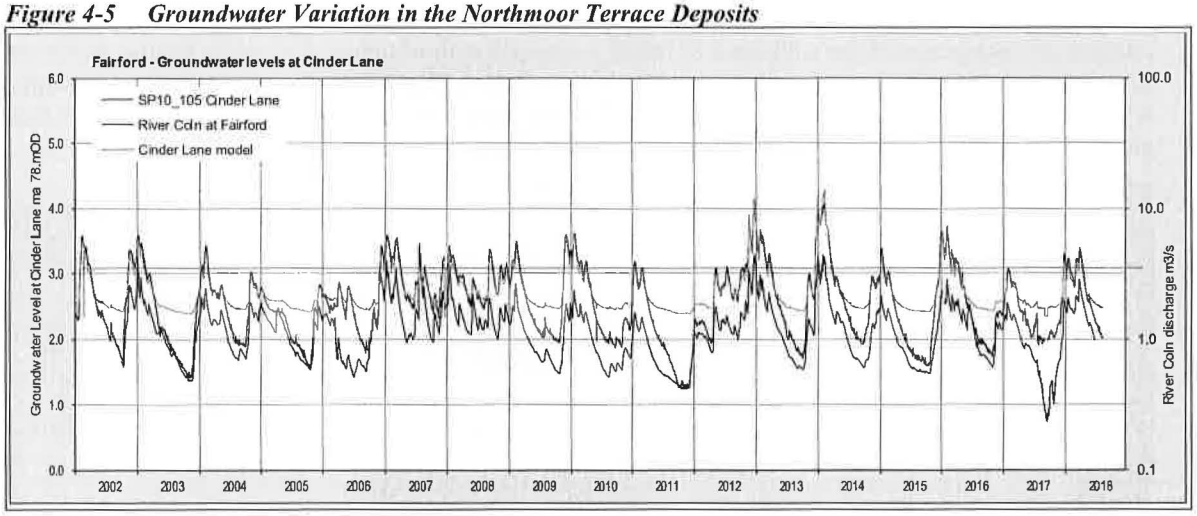
Date	GWL		Date	GWL		Date	GWL
02-Jan-03	81.230		16-Jan-08	81.120		07-Feb-14	81.272
10-Jan-07	81.181		29-Dec-12	81.283			
22-Jul-07	81.452		07-Jan-14	81.250			

The groundwater levels depicted in Figure 4-5 correlate well with the streamflow record in the River Coln, which is useful in estimating a broader range in extreme groundwater levels. Another regression equation was used to relate Cinder Lane groundwater level to Flow in the River Coln, so that a longer period of record could be simulated, 1991-2018. It should be emphasized that this model is biased towards predicting

maximum groundwater levels only, and does not accurately portray summer and drought water levels. The following records of stage and mean daily discharge were analysed:

- 39110 – River Coln at Fairford [415000, 201200], feb1991-jul2018.
- 39020 – River Coln at Bibury [412100, 206200], jan1963-aug2018.

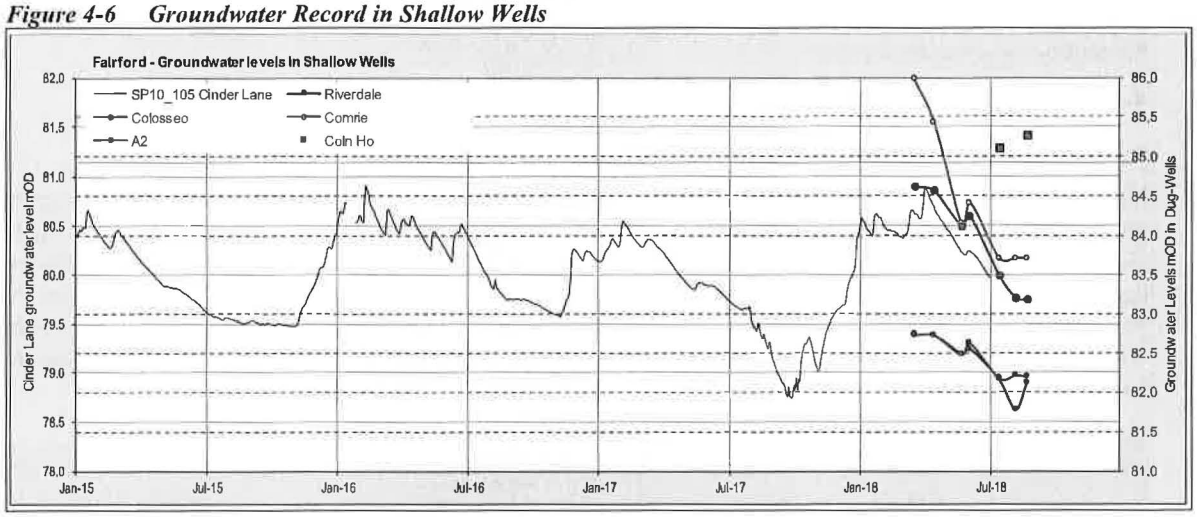
Figure 4-5 Groundwater Variation in the Northmoor Terrace Deposits



4-2-3 Groundwater Level in Shallow Wells

The project included monitoring in four dug-wells in the town area, and the record for Mar-Aug 2018 has been compared with the long-term monitoring sites at Cinder Lane, Burdocks and Ampney Crucis. Comparison with the Cinder Lane hydrograph is shown in Figure 4-6. As would be expected, the groundwater recession in 2018 at all sites is comparable, and the sites show the start of the autumnal rebound after mid-August.

Figure 4-6 Groundwater Record in Shallow Wells

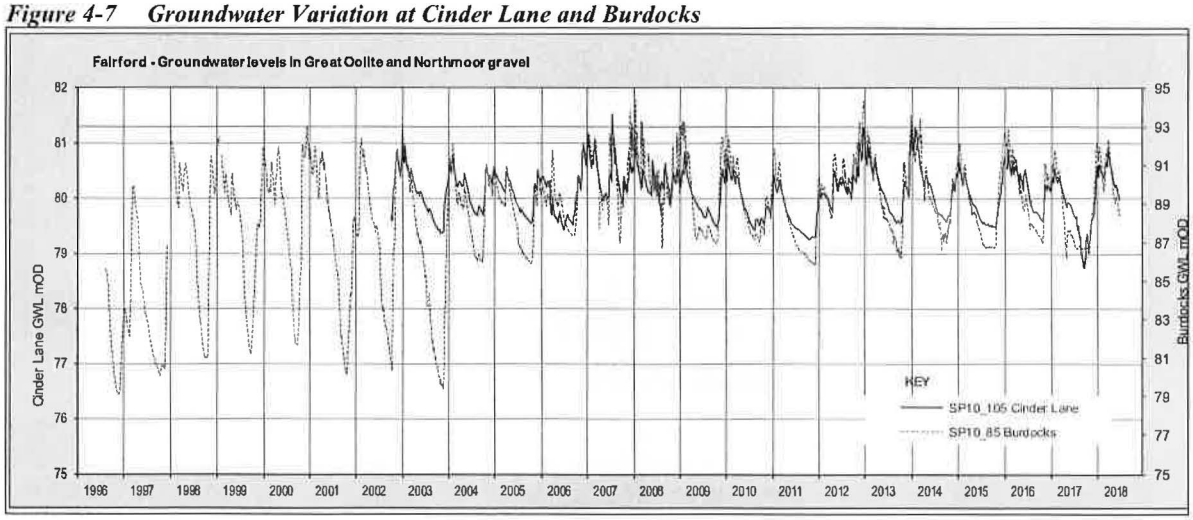


4-2-4 Groundwater Level in the Cornbrash

The Cornbrash limestone is relatively thin and although water levels appear to be high during most winters, the formation can dewater during summer months. Two wells were inventoried and monitored [Comrie and Dynevor Place] and they were both dry by 17-Jul despite having over 2 m of water in the well in winter. Likewise, springs at the junction of Lovers Lane and Leafield Road flow in winter to feed the Thornhill Brook, but they also dry up over the same period. No doubt, for this reason, the Cook Trust decided to backfill an old well at the Orangery near its Estate offices in Fairford Park.

Although classified as the Great Oolite Group, the degree of connectivity between the deeper limestones and Cornbrash is not known. It would appear that the Forest Marble mudstone is sufficiently thick and laterally continuous to provide a significant barrier to vertical movement, so that the borehole at Burdocks becomes positively artesian [overflowing] in most winters. This was evident in the record provided by the Environment Agency in file comments such as "reset to 91.32, note borehole now artesian, not as accurate when artesian". In fact, in recent years, the logger needs regular resetting due to this feature, and really requires reconstruction of the well-head to install a longer length of tubing. The other feature worth noting is the impact of Meysey Hampton abstraction in the record up to Dec-2003, when presumably TWU pumped less from this source. The pre-2003 pumping would have depressed the peak groundwater levels, so that the observation borehole overflowed to a lesser extent. The details are shown in Figure 4-7.

Figure 4-7 Groundwater Variation at Cinder Lane and Burdocks



The confinement of the Forest Marble limestone means that this borehole is less able to represent the aquifer of interest in Fairford, namely the Cornbrash. Reliance has to be placed then on the short records from boreholes and shallow wells in the Cornbrash [Dynevor, Comrie, B2 and B5] to attempt to examine seasonal fluctuation in groundwater level.

4-3 Maximum Groundwater Levels

4-3-1 Frequency Analysis

Extreme value frequency analysis was carried out of the available records in order to estimate maximum groundwater levels: the results are shown graphically in Figure 4-8, and summarised in Table 4-4. Potential groundwater flooding is assessed with reference to the 1 in 200-yr groundwater level [T200], and this shows that levels would exceed ground level at Riverdale and Comrie. While this is likely to be true of the Northmoor terrace, it is geologically less likely at the higher-level Cornbrash site where groundwater maxima will be depressed by peripheral spring discharge, as with the Ampney Crucis record. It can be concluded however that groundwater levels will be close to the surface in T200 conditions.

Table 4-3 Summary of Maximum Predicted Groundwater Levels [mOD] for Fairford Town

Site	Max mOD	T500	T200	T100	T50	T25	T10	T2	T200 - max	GL mOD	Free-board
Cinder Lane	81.45	82.29	82.07	81.90	81.73	81.56	81.34	80.88	0.61	83.30	1.24
Riverdale	83.75	84.24	84.05	83.90	83.75	83.60	83.40	83.00	0.30	83.90	**-0.15**
Colosseo	84.30	83.78	83.64	83.54	83.44	83.33	83.19	82.92	-0.66	84.10	0.46
Comrie	88.10	89.19	88.70	88.33	87.95	87.58	87.07	86.07	0.60	88.10	**-0.60**
A2	84.94	86.40	86.11	85.88	85.66	85.43	85.13	84.52	1.16	87.30	1.19
Burdocks	94.34	97.36	96.58	95.98	95.39	94.79	93.98	92.37	2.24	88.50	**-8.08**
Ampney Circus	103.45	103.91	103.76	103.65	103.54	103.43	103.27	102.97	0.31	109.50	5.74

Note: Negative freeboard indicates groundwater levels above ground level. Confidence limits have been shown on graphs in Appendix B-4.

In contrast, the higher Summertown terrace shows that groundwater rise is contained with more than a metre of freeboard under T200 conditions. These results have been mapped in Figure 4-9.

Figure 4-8 Frequency Analysis of Simulated Groundwater Levels, 2002-2018

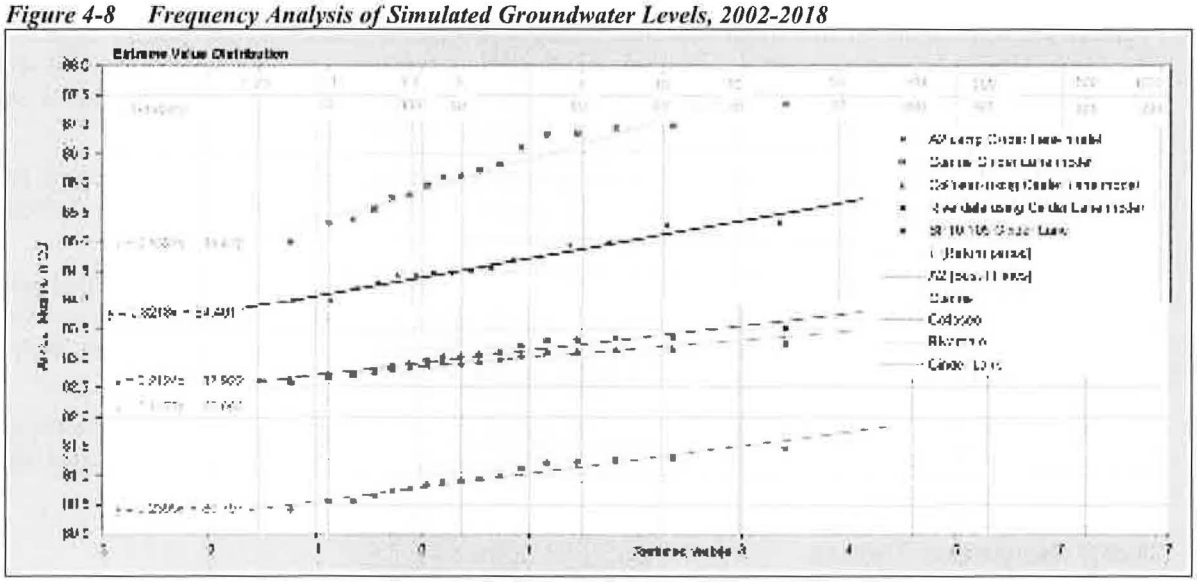
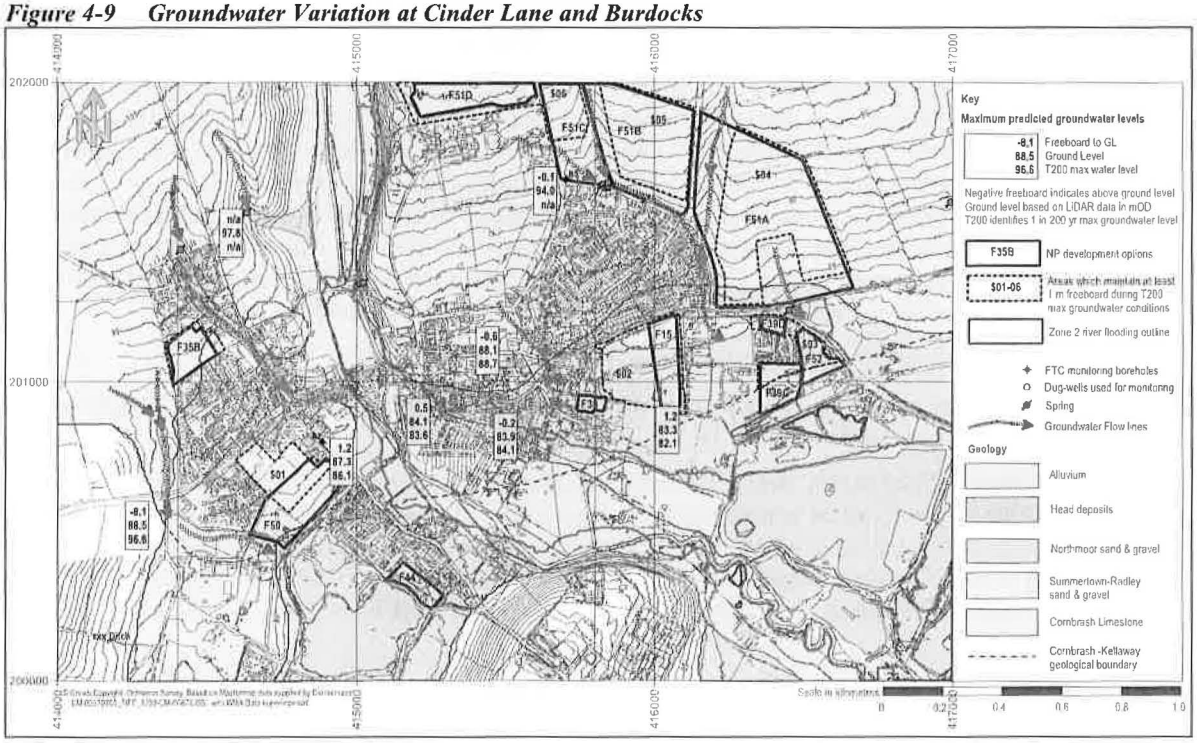


Figure 4-9 Groundwater Variation at Cinder Lane and Burdocks



The importance of the analysis in this section is to allow an estimate of potential maximum groundwater levels which lie beyond the elevations observed during the period of monitoring in 2018. The predicted values should be used as a guide rather than providing definitive values, and they allow some useful conclusions.

The characteristics of different parts of Fairford town are now discussed by geological formation, with particular reference to the freeboard available at maximum groundwater levels, to assess the comparative risk of groundwater flooding and to examine whether drainage schemes such as SuDS would be able to operate effectively. CIRIA guidelines emphasise that effective SuDS infiltration schemes should ensure that groundwater levels are at least 1 m below the base of soakaway pits or trenches.

4-4 Implications for Development

4-4-1 Summertown-Radley Terrace

This terrace is generally an area where seasonally there is permanent groundwater at shallow depth above the Forest Marble Formation, and the maximum values remain well below the ground surface. The area is characterised by the new A2 borehole and the well at Coln House West, where the terrace thickness varies from 3.0 to 4.4 m respectively overlying Cornbrash limestone to a depth of about 7 m bgl.

Groundwater levels are closer to the surface in the vicinity of Coln House West than at A2. In conclusion, this area can be considered as generally an area with perennial groundwater in the terrace and underlying Cornbrash, and is unlikely to experience groundwater flooding.

Although this area would seem to be the area with best characteristics, there is only one site F50 identified for assessment in the planning proposals. Parts of this site along the southern boundary and south-west boundary will experience high groundwater levels, where the area lies along the boundary with the Northmoor terrace deposits and valley of the Dudgrove Brook.

The area with optimal scope for SuDS and free of groundwater flooding is the area immediately to the north of F50 and the northern portion of the proposed development site: this optimal area is designated $01 in Figure 4-9.

4-4-2 Northmoor Terrace

Groundwater levels in the Northmoor Terrace deposits in general reflect the regime of the River Coln, being masked and delayed further away from the main river channel.

There is only one site shown west of the River Coln in the Horcott area at F44. Although no groundwater data were retrieved during the monitoring for that area, the area is low-lying [83 to 84 mOD] and of a similar elevation to the Cinder Lane borehole [83.3 mOD]. Cinder Lane was modelled to have a freeboard of 1.2 m at T200 conditions. Horcott Road forms a ridge between the river and old gravel workings to the west of F44, which implies that groundwater discharge in the lake due west of the proposed site would then control the hydraulic head in the terrace deposits. As river flood level on the other side of the road is of the order of 84.0 mOD, this would suggest that F44 would be vulnerable from both the impact of this flood level and backing-up of groundwater entering the lake, to the extent that the site would in fact flood.

Unlike F50, no area can be considered suitable at this location.

The majority of the proposed development sites in the Northmoor terrace deposits are located east of the river and south of London Road: F15, 38, 39C, 39D and 52.

These sites benefit from having data at Cinder Lane, Chapel Electronics and the newly-constructed housing estate at Keble Fields [Ground investigation for Kensington & Edinburgh Estates, by Hydrock July 2014]. The simulation at Cinder Lane indicates that there would remain a freeboard of 1.2 m under T200 conditions, particularly where Northmoor deposits overlie the Cornbrash limestone. This would suggest that the majority of site F15 and F39D satisfy this condition, whereas parts of sites F39C and F52 are likely not to have freeboard.

Site F38 [due north of Moor Farm] is closer to the monitoring well at Riverdale [London Road] which was modelled to show that there would be no freeboard and a risk of groundwater flooding in T200 conditions.

An indication has again been shown in Figure 4-9 of open areas which would retain more than a metre of freeboard in the predicted flood conditions. The areas are designated $02 and $03.

4-4-3 Cornbrash

There are two areas of town, to the west and east of the Coln valley, where proposed development has been designated in ground underlain directly by Cornbrash Limestone. The area on the west side of town is generally known as Milton and the area to the east is the Leafield Road area. At Milton, information was obtained from a dry well at Dynevor Place, and at Leafield Road, geological information was supplemented using two boreholes, B2 and B5. Unfortunately, a six-month record of groundwater levels was not collected

from these sites, as B2 has not been equipped with piezometer tubing, and B5 was only drilled in August 2018. Monitoring of the B5 borehole will provide further data to refine the assessment of sites F51A-C

In general terms, the Cornbrash outcrop area is characterised by groundwater levels close to the surface during winter followed by progressive dewatering of the formation during the spring and summer recession. Lithological discontinuities in the formation cause ephemeral springs to occur, of which there are group between B2 and B5 and there is also evidence of springs or groundwater discharge in the shallow valley infilled with head deposits west of Dynevor Place, which follows a route under Milton Farm and into the Coln.

Site F35B lies away from the line of this dry valley, so should have reasonable freeboard during times of high groundwater.

The broad corridor of cultivated land between Leafield Road and London Road [F51A-C] is characterised by groundwater levels close to the surface during winter and at several locations, the groundwater discharges at springs or causes fields to become waterlogged. The low-lying parts of this area do not achieve the desired freeboard, and special drainage considerations would be required should those areas be developed. An indicative line is again provided using the designation $04.

Finally, site 51D in Fairford Park is at a generally higher elevation and should achieve the required freeboard. Groundwater flowlines have been drawn on Figure 4-9: as a general principle, areas adjacent to and at the outlet of those flow-paths would be expected to have higher aquifer permeability and high groundwater levels during flood conditions.

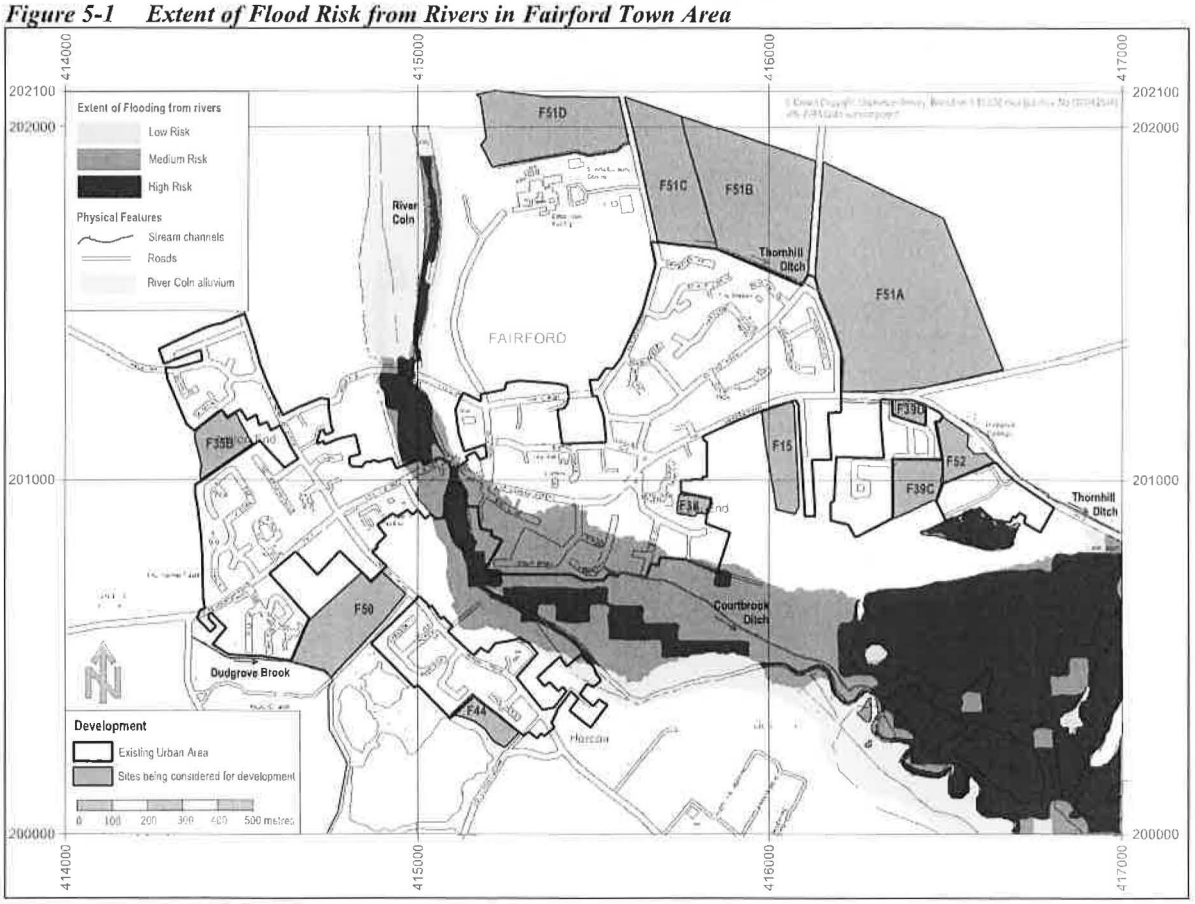
5 Surface Water Review

5-1 General

A review has been made of the results of work carried out by the Environment Agency, Thames Water and Gloucestershire Highways, and validity of the conclusions reached. A review has also been made of the design flood adopted by the Environment Agency for the Fairford Flood Alleviation Scheme on the River Coln.

Fairford is located on the River Coln that drains a catchment of 129 km^2 upstream of the town. This flows from the Cotswolds limestones from just east of Cheltenham in a south easterly direction and meets the gravel beds of the Upper Thames valley at Fairford. Because the area to the west and south of the town centre is a broad flat floodplain, there is an extensive area at risk from fluvial flooding as shown in Figure 5-1, and the area of old gravel workings to the south east of the town is particularly vulnerable. The outer 1% flood risk line corresponds very closely to the areas of the town that were flooded in the July 2007 flood [described in the Environment Agency report on 2007 flood], and this is within flood zone 3 and hence not suitable for development.

Figure 5-1 Extent of Flood Risk from Rivers in Fairford Town Area



Key: Simplified sketch based on Environment Agency Flood Map: dark blue indicates areas with a greater than 3.3% annual risk of flooding [1:30 years] and the pale blue area has risk of 3.3% to 1% [between 1:30 and 1:100 years].

GCC is the Lead Local Flood Authority (LLFA) under the Flood and Water Management Act 2012, and has responsibilities for investigating and reporting flooding incidents and managing flood risk from surface water, groundwater and ordinary watercourses (non-main rivers). GCC's Local Flood Risk Management Strategy [LFRMS, 2014) states that it has delegated the consenting and enforcement role to district councils such as CDC, and has updated the consenting and enforcement protocol in partnership with them. Its Annual Progress and Implementation Plan 2017/18 for Fairford records the number of properties affected as greater than 100, with 50 to 75 properties at high risk [based on the Environment Agency's updated Flood Maps for

Surface Wate, uFMfSW]. It classifies the flood risk as High and also records 'Scheme complete 'for the Environment Agency river flood alleviation scheme at Fairford.

Gloucestershire SuDS Design & Maintenance Guide notes that some areas of the Cotswolds can be affected by high groundwater levels, and those sites would be investigated using infiltration tests. This is likely to be the case in planned development at Fairford.

The GCC Groundwater Intermediate Assessment for South Cotswold District [Atkins, April 2015] reports the following: "Groundwater level data have indicated that there is the potential for groundwater levels to be above, at or approaching the ground level in a number of locations (including Fairford). The lower lying land to the south of the Cotswold District is shown to have areas that have a higher potential risk of groundwater flooding due to a combination of low gradient land, the presence of superficial deposits with a high percentage coverage of sands and gravels and underlying mudstones, together with historic flooding."

Dudgrove Brook drains the W side of Fairford into Horcott lakes [old water-filled gravel workings on the south side of Horcott] and then collects discharge from the lakes, and from land drains from the fields around, and runs across the Fairford Air Base and across gravel workings before discharging into the River Coln at Dudgrove. Because of previous flooding problems and the sensitivity of the site, this discharge is released at a limited controlled rate, which is regulated by Environment Agency [Information provided by FTC].

Court Brook was the original town sewer, and the ditch runs at a lower level than the River Coln.

The CDC report discusses the flood pressure on sensitive areas in and around Fairford with a number of key paragraphs from their report repeated below:

7.5.1 The main area in the District which has particularly complex flood risk issues is the Cotswold Water Park. The Environment Agency has advised that any further development in this area will require further work to fully appreciate the complex fluvial, groundwater and lake interactions. Without a full appreciation of this interaction, development should not go ahead.

8.6 Application of the Sequential Approach to Other Sources of Flooding.

8.6.1 Development proposals in any location [Flood Zones 1, 2, 3a and 3b] must take into account the likelihood of flooding from sources other than rivers and the sea [where applicable]. The principle of locating development in lower risk areas should therefore be applied to other sources of flooding.

8.6.2 The information collated within the SFRA has identified areas in which risk from other sources of flooding is likely to be an important consideration. The Council should therefore use the Sequential Approach to steer new development away from areas at risk from other sources of flooding, as well as fluvial.

8.6.3 The SFRA has highlighted areas where information of flooding from other sources is currently poorly understood or will require further refinement in the future. Of particular relevance is the fact that the Environment Agency now requires further investigation/mapping of surface water flooding to be carried out as part of a Level 2 SFRA, to ensure that potential allocations can be Sequentially Tested against this source of flooding.

The Pitt report on the 2007 floods identified Fairford as one of the areas worst-affected by surface water flooding and where properties were also affected by sewer flooding. The report states "*on 20th July 2007 Exceptionally heavy rainfall fell onto already saturated ground resulting in quick, widespread flooding from a variety of sources, not just watercourses. As well as extremely high river flows, it is important to note that surface water, sewer and groundwater flooding played a considerable role in the summer flood event, adding to the complications. Drains and sewers were overwhelmed by the intense and prolonged rainfall, rapidly causing flooding*". The report went on to state that there were a number of discrepancies in the Environment Agency flood maps in the Cotswold area and that "*consultation with EA staff has indicated that there is a complex relationship between the river Coln, Court Brook [draining from Fairford] and existing gravel pits. This is an area where development is underway and is also proposed. It should be highlighted that there is a need for further modelling work in this area*".

During the 2007 flood Fairford suffered from both overflowing of the River Coln and also from surface runoff from fields and paved areas and the sewerage system was overwhelmed during the event. The Hyder post-flood report of 2008 summarised the flood problems experienced and proposed a number of remedial actions which in most cases have now been implemented.

Similarly, the Thames Water Strategy study report identified a number of problems within the town where sewers had been overwhelmed during heavy rainfall events and some of these issues have subsequently been resolved with a major survey of the piped sewerage system undertaken recently. Some of the remaining sewer problems arise from infiltration of high groundwater levels into the system, a major problem because of the alluvial and terrace gravels which underly much of the town. Other problems arise from surface water mis-connections and surface runoff from roads and public spaces finding their way into the system.

5-2 SuDS

Urban sustainable drainage systems [SuDS] are current 'best practice' for new urban development with the objective of minimising the impacts upon the local pre-development drainage regime. This may be achieved through the use of permeable areas to encourage infiltration or through construction of attenuation ponds to restrict runoff from the site to less than the original 'green field' rate.

Thames Water suggests that SuDS solutions using infiltration are unlikely to be effective in the low-lying areas to the south of the town because of frequent high groundwater levels. In their CDC Strategic Flood Risk Assessment report, JBA also suggest that SuDS drainage using infiltration is unlikely to be feasible for those areas to the south and southeast of Fairford. Thus, it is likely that SuDS drainage in such areas would only be possible through the use of quite significant areas of shallow attenuation ponds because of the high groundwater levels in these areas; attenuation ponds would have to be shallow to avoid ingress of groundwater and hence would have to occupy a significant portion of any site.

Some SuDS designs may aim to raise the ground level which would have the following result:

i) Reduction in floodplain storage and conveyance capacity thereby increasing flood risk elsewhere.
ii) Risk of increasing run-off and flooding elsewhere, although reducing flood risk on the site itself.
iii) Improved viability of infiltration systems due to the increased margin above the maximum groundwater level.
iv) Improved freeboard for attenuation storage, thereby reducing the land area required.
v) Increased elevation and visual impact of the development on the landscape.

Such schemes imply raising ground levels significantly over large areas, which would generally be impractical or unacceptable.

6 Conclusions

6-1 Groundwater

6-1-1 The Summertown-Radley terrace deposit and underlying Cornbrash has permanent groundwater and represented by data from A2 and Coln House dug-well. Although groundwater levels are closer to the surface at Coln House dug-well, the area is generally unlikely to experience groundwater flooding and maximum levels remain well below ground surface for SuDS schemes.

6-1-2 Part of the F50 site along the southern boundary and south-west boundary will experience high groundwater levels, where the area lies along the boundary with the Northmoor terrace deposits and valley of the Dudgrove Brook.

6-1-3 Groundwater in the Northmoor Terrace reflects the regime of the River Coln which dominates F44. Although Horcott Road forms local high ground, F44 is low-lying and vulnerable to groundwater flooding. No area can be considered suitable at this location.

6-1-4 The other Northmoor terrace sites are located east of the river at F15, F38, F39C, F39D and F52. Represented by Cinder Lane F15 and F39D satisfy requirements and could be larger, whereas parts of sites F39C and F52 are likely not to have sufficient freeboard. F38 is closer to the monitoring well at Riverdale which showed a risk of groundwater flooding in T200 conditions.

6-1-5 The Cornbrash outcrop area is characterised by groundwater levels close to the surface during winter which give rise to numerous springs, followed by progressive dewatering of the formation during the spring and summer recession. Evidence of groundwater discharge was confirmed in the shallow valley infilled with head deposits west of Dynevor Place, which follows a route under Milton Farm and into the Coln. The Milton site F35B is distant from this dry valley, so should have reasonable freeboard during times of high groundwater, as confirmed in the dug-well at Dynevor Place.

6-1-6 At the Leafield sites F51A-C, groundwater levels are artesian and close to the surface during winter at several locations, and geological data was provided by boreholes B2 and B5. The low-lying parts of this area do not achieve the desired freeboard, and would be subject to groundwater flooding.

6-1-7 Fairford Park site 51D is at a higher elevation and should achieve the required freeboard. Groundwater flowlines have been drawn to identify areas which would be expected to have higher aquifer permeability and high groundwater levels during flood condition.

6-1-8 The suitability of possible development sites has been summarised in Table 6-1 by applying the CIRIA guideline that the base of soakaways should be built at least 1 metre above maximum groundwater level.

Table 6-1 Suitability of Development Sites from a Groundwater Perspective

Site	Description	Geology	Suitability	Map Area[1]	Comment
F_15	Jones Field	Northmoor	Full	$02	
F_35B	Land behind Milton Farm	Cornbrash	Full	F_35B	
F_38	Land east of Beaumoor Place	Northmoor	No	n/a	
F_39C	Field SE of Keble Fields	Northmoor	Partial	n/a	Northern part only
F_39D	Land at London Road (Bovis)	Northmoor	Full	$03	
F_44	Land at Faulkners Close	Northmoor	No	n/a	
F_50	Land West of Horcott Road	Summertown-Radley	Partial	$01	Northern part only
F_51A	Land East of Leafield Road	Cornbrash	Partial	$04	Avoid flow-paths
F_51B	Land East of Leafield Road	Cornbrash	Partial	$05	Avoid flow-paths
F_51C	Land East of Leafield Road	Cornbrash	Partial	$06	Avoid flow-paths
F_51D	Land West of Leafield Road	Cornbrash	Full	$06	
F_52	Land West of Terminus Cottage	Northmoor	Partial	n/a	Northern part only

Note. [1] Map reference refers to Figure 4-9.

6-2 Floods and SuDS

6-2-1 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.

6-2-2 There have also been floods from surface runoff and also from an overwhelmed sewer system. As part of any further development developers should contribute to significant improvement in the sewer system.

6-2-3 There is no scope for SuDS drainage using infiltration in the low-lying areas associated with alluvial deposits of the Coln valley due to frequent high groundwater levels.

6-2-4 Attenuation storage ponds in low-lying areas provided as a SuDS solution can only take the form of shallow depressions that would require significant land.

6-2-5 Ideally development should be directed away from the Coln and Court Brook corridor.

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Appendix A Terms of Reference

Introduction

This document provides an outline scope of work required by Fairford Town Council [FTC] from consultants, Water Resource Associates [WRA] for the proposed investigation and monitoring of groundwater levels in areas of proposed development at Fairford. The work also covers a review of documents produced by its consultants and utilities related to flooding in the town.

The Fairford Neighbourhood Development Plan [NDP] was recently rejected by the inspector 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 is therefore commissioning a hydrological study to provide that hard evidence.

Objectives of the Assignment

The scope of the work will include:

- Review of relevant reports, maps and documents such as geological map and memoirs, borehole records and flood-related reports.
- Collation and review of all relevant geological, hydrological and hydrogeological data and documentation available from the Environment Agency [EA], the British Geological Survey [BGS] and other relevant bodies, including records of groundwater and surface water levels.
- 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 [mapping] 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 which are secure from vandalism.
- Groundwater level monitoring for a period of three months [December 2017 to February 2018].
- Hydrogeological analysis of long-term historical groundwater records and correlation with data captured by the new piezometers for prediction of conditions at the Development Sites listed in Appendix 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 overall assignment will focus on groundwater, but will also include a review of all previous studies to define comparative risk of surface flooding for sites close to the river and those further away.

The area of study is shown in Figure 1. A definitive list of development sites is given in Appendix 1. The study will investigate and report the comparative risk of flooding and groundwater levels in those areas. The consultant should be aware of two residential developments under construction, namely the Bloor2 and Bovis estates.

Task 1 Data acquisition, reconnaissance and Mapping

Relevant reports in the possession of FTC or Cotswold District Council [CDC] will be provided and supplemented where possible by other documents prepared either by Thames Water [TW] or Gloucestershire County Council [GCC] on the matter of flooding in the town.

Complete records of hydrological data will be requested from the two main organisations monitoring groundwater and surface water in the area, namely the Environment Agency and Thames Water. This will include but not be limited to acquisition of water level time series at the following locations:

- Cinder Lane Borehole
- River Coln Flow Gauge
- Ampney Crucis Borehole

The consultant will identify wells and springs in the study area which may provide important information on the seasonal variation in groundwater levels in different geological formations. This will be done using BGS records as a starting-point, then following up leads by on-foot reconnaissance talking to residents, with the support of FTC where

possible. Water levels will be measured and historical records retrieved when feasible, to produce an inventory of data and water levels.

The relevant LiDAR data-tiles will be downloaded by the consultant from the Environment Agency website and processed using GIS software to produce a digital terrain model and contouring for the study area. This topographic information will be overlain on geological mapping to investigate lineaments and micro-relief of the town area and help improve the siting of proposed groundwater monitoring points.

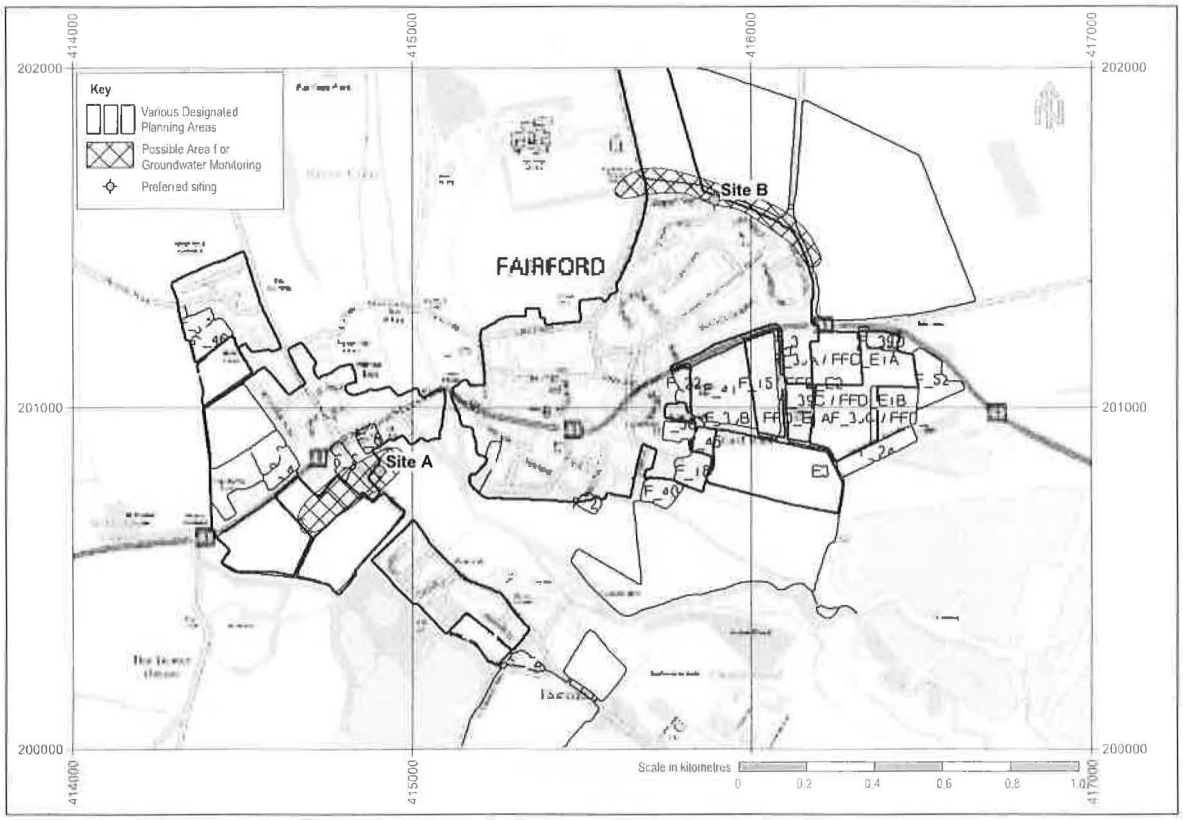


Figure 1 Fairford Town Study Area and Monitoring Sites

Task 2 Exploratory Drilling and Piezometer Construction

The aim of the drilling and piezometer construction is to establish the thickness of formations and variation in groundwater level at two proposed sites, designated as follows:

- Site A will be located on the western edge of the Coln House School rugby pitch field [owned by GCC Education Department] north of the Horcott Road gate, to establish groundwater levels in the Summertown-Radley Sand and Gravel Member of the Quaternary Period.
- Site B will be located on the north-eastern edge of town at the end of St Marys Drive, to establish groundwater conditions in the Cornbrash limestone.

If these locations are considered to be inappropriate by the consultant, or if there are difficulties in obtaining landowner permission, the consultant will advise on alternative siting to achieve the aims of characterising and monitoring the two geological formations.

The drilling of the two boreholes will be carried out using small diameter and lightweight drilling rigs, at size sufficient to identify the lithology of samples retrieved from the borehole and to allow for piezometer construction.

The maximum drilling depth will be dictated by the underlying clay formation, and allowance should be made to penetrate the clay layer by at least 0.3 metres.

At Site A, the anticipated geological succession will be:

- 0.0 - 4.0m Summerton sand and gravel
- 4.0 - 9.0m Cornbrash Limestone

- 9.0 - 9.3m Forest Marble mudstone [clay]

At Site B the anticipated geological succession will be

- 0.0 - 6.0m Cornbrash Limestone
- 6.0 - 6.3m Forest Marble mudstone [clay]

The anticipated drilling depth will therefore not exceed 10 m, and the more complex drilling will occur at Site A, which may have two separate groundwater levels, one in the sand and gravel deposits and another level in the Cornbrash limestone, unless the two formations have hydraulic continuity.

It may be appropriate to install two piezometers in the same borehole at Site A, in order to monitor groundwater levels in each aquifer. This option should be investigated by the consultant, and the appropriate drilling and construction method identified.

Each piezometer will be equipped with a groundwater level sensor and data-logger, housed securely in a small concrete chamber at the head of the borehole and protected by a steel plate which can be locked and opened for ease of access during the monitoring activities.

Task 3 Groundwater Level Monitoring and Hydrogeological Analysis

Once the field activities and piezometer construction has been completed, the two monitoring sites will be maintained during a period of three months. This will involve monthly download of the data-loggers to ensure accuracy and to carry out manual observation of water levels to verify logger accuracy.

If other wells and groundwater features in the town and vicinity are deemed to be important by the consultant, arrangements should also be made to include those sites in the monitoring campaign.

On completion of the groundwater monitoring period, the consultant will process and analyse all hydrological data collated, including the output from the data-loggers at piezometers A and B, and examine the correlation of short-term records with long-term groundwater records in order to predict seasonal fluctuation and the range in groundwater levels at the development sites of interest.

The final result will provide a frequency analysis of groundwater levels, and identify the freeboard available for residential development. The freeboards will be compared between different development sites to make a comparative risk of groundwater flooding and to examine whether drainage schemes such as SuDS would be able to operate effectively.

Duration of the Assignment and Deliverables

Duration of the proposed assignment will be five months, divided into two main stages. The bulk of the work will be done in the first month, and this will then be followed by monitoring activities, analysis and reporting. The two stages are expected to be divided as follows between the two stages:

Stage 1 will take three months to complete, and will involve data acquisition, reconnaissance, mapping, drilling, piezometer construction, groundwater monitoring, hydrogeological analysis and preparation of a draft report. This report will be submitted before the **end of March 2018**.

Stage 2 will involve a review of the results of the work by FTC, facilitated by a presentation and meeting in Fairford. FTC may wish to follow up queries raised during the meeting, or not addressed in the draft report, and would provide the consultant with comments so that a final version of the consultant's report can be prepared for submission by the **end of May 2018**. The final report will be used to substantiate the revised NDP and provide quantified evidence of groundwater at appropriate locations.

All data collated and used in the study will be provided in electronic form, together with two bound hard-copies of the report and copy in digital form.

The study will be carried out for a Lump Sum fee, against work identified in a brief proposal to be submitted no later than **12th December 2017** for a start date in **early January 2018**. The cost should be broken down into the individual work components, and allow for the submission of regular progress bulletins and a final presentation of the conclusions to the client.

FTC will arrange with respective landowners the necessary permissions for the consultant to enter land and carry out the exploratory drilling and piezometer construction. This will include the arrangement to subsequently monitor water levels during the project duration.

TOR APPENDIX 1 – Potential Development Sites

SHLAA Ref	FNP Ref	Site Location
F_15	x	Jones's Field (Morgan Hall Field)
F_20A	x	Land south of Cinder Lane
F_35B	x	Land behind Milton Farm
F_39A	x	Land off London Road (FTFC Practice Ground)
F_39B	x	Fairford Town Football Club football ground site
F_39C	x	Field South East of Keble Fields (Bovis).
F_44	x	Land behind Faulkners Close
F_45	x	Land south of Morgan Hall
F_50	x	Land west of Horcott Road
F_51A	x	Land east of Hatherop Road
F_51B	x	Land west of Hatherop Road
F_51C	FNP 16	Land east of Leafield Road
F_2	FNP 19	Lower Croft
x	FNP 22 (vii)	Land off Rhymes Lane
x	FNP 3	Land at East End (SHLAA ref F_38)
x	x	Jones Field west of Cinder Lane

UPDATE OF SITE ASSESSMENT DURING THE COURSE OF THE PROJECT:

NB: The following seven sites were excluded from the study, since they had already been developed or are no longer in scope: F_20A, F_39A, F_39B, F_45, F_2, FNP-22, FNP-3.

Furthermore, the following four sites were added:

- F_38 Land East of Beaumoor Place
- F_39D Land at London Road [Bovis]
- F_51D Land West of Leafield Road
- F_52 Land West of Terminus Cottage

Appendix B Hydrological Data and Analysis

B-1 Well Inventory

Ref	Address	Owner / contact	Easting	Northing	GL	WellTop	Depth	Dia	Stick-up
					mAOD	mAOD	m bWT	mm	WT-GLm
1	Riverdale. London Road	Kevin Wigham	415557	200928	83.90	83.90	1.90	700	0.00
2	2 Eastbourne Terrace	Jason Baker	415518	200924	83.90	83.90	-	-	0.00
3	Colosseo Restaurant, London Rd	Sous Guenaoua	415223	200970	83.65	84.40	2.85	-	0.75
4	Comrie [Dovecote House]	Mr&Mrs deCourcy-Ireland	415387	201183	86.20	86.75	4.32	780	0.55
5	Moor Farm	Margaret Bishop	415870	200855	83.00	83.00	1.34	-	0.00
6	Well House, 2 Coronation Street	-	414756	200928	88.00	88.00	-	-	0.00
7	Coln Ho Reform School -front yard	GCC	414767	200910	87.00	87.00	4.33	800	0.00
8	Borehole A2	FTC	414911	200812	87.30	87.30	6.70	50	0.00
9	Borehole B2 [backfilled]	FTC	415908	201604	91.20	91.20	4.47	50	0.00
10	Borehole B5	FTC	415704	201675	94.00	94.00	4.10	50	0.00
11	Thornhill Farm	New owner	418080	200520	80.30	80.30	8.84	950	0.00
12	Cinder Lane observation BH	Environment Agency	416118	200900	83.31	83.95	4.60	200	0.64

Ref	GL	WellTop	Depth	Dia	Stick-up	Monitoring in 2018: RWL in metres bgl						
	mAOD	mAOD	m bWT	mm	WT-GLm	*20-Mar*	*17-Apr*	*25-May*	*06-Jun*	*17-Jul*	*09-Aug*	*25-Aug*
1	83.90	83.90	1.90	700	0.00	1.030	1.030	1.264	1.200	1.600	1.980	1.640
2	83.90	83.90	-	-	0.00	-	-	-	-	-	-	-
3	83.65	84.40	2.85	-	0.75	1.560	1.575	1.820	1.675	2.130	2.090	2.110
4	86.20	86.75	4.32	780	0.55	2.130	2.680	3.960	3.690	4.400	4.400	4.400
5	83.00	83.00	1.34	-	0.00	dry	-	-	-	-	-	-
6	88.00	88.00	-	-	0.00	-	-	-	-	-	-	-
7	87.00	87.00	4.33	800	0.00	-	-	-	-	1.895	-	1.730
8	87.30	87.30	6.70	50	0.00	2.680	2.740	3.183	3.060	3.820	4.100	4.130
9												
10	94.00	94.00	4.10	50	0.00	-	-	-	-	-	-	-
11	80.30	80.30	8.84	950	0.00	-	0.820	-	-	-	-	-
12	83.31	83.95	4.60	200	0.64	3.00	-	-	-	-	-	-

Ref	Address	Location	Access	Condition. Dipping Point
1	Riverdale. London Road	Rear west of property	Steel manhole cover	manhole cover [edge]
2	2 Eastbourne Terrace	In sitting room	Removable glass plate	
3	Colosseo Restaurant, London Rd	Behind bar	Removable wooden cover	Top of well, bar side
4	Comrie [Dovecote House]	In garden	Walled and grilled but open	max WL 1m bwh. Top of well, south side
5	Moor Farm	In garden by wall	Steel manhole cover	dry, part full of sand
6	Well House, 2 Coronation Street	Inaccessible	Located inside the house	-
7	Coln Ho Reform School -front yard	No opening in well-head	Concrete caisson	
8	Borehole A2	Rugby Club field	14mm socket wrench	New: Top of casing
10	Borehole B5	Woodland on Lovers Lane	Allen key	
11	Thornhill Farm	Inside the main farm bdg	Glass cover in kitchen floor	Recently cleaned out max WL 0.41m below kitchen floor
12	Cinder Lane observation BH	Corner of Football ground	Through FTC gate	Good. Top of casing

B-2 GeoIndex Archive

Id	Location Id	Depth [m]	Built	Aquifer	East	North	Start	Contin	End
SP10/24	Fairford Deer Park	2.5	1941	Alluvium	414980	202290	-		-
SP10/85	Fairford Burcotts	79.0	1982	Great Oolite Formation	414330	200590	-		-
SP10/52	Horcutt Lane Fairford	35.8	1924	Great Oolite Group	414800	200900	-		-
SP10/100	Fairford Chapel Electronics	4.0		River Terrace Deposits	416720	200980	-		-
SP10/105	Fairford Football Club	4.6	2002	River Terrace Deposits	416119	200903	-		-
SP10/31	Thornhill Farm Fairford	30.5	1955	Great Oolite Formation	418080	200510	-		-
SP10/46	Pittam Boring Quenington	39.9	1935	Great Oolite Formation	414190	203310	-		-
SP10/104	Leafield Farm Quenington	75.0	1996	Great Oolite Formation	415580	203900	-		-
SP10/80	Barrow Elm Cottage	3.4		Cornbrash Formation	416710	203900	-		-
SP10/103	Milton Farm, Fairford	75.0	1995	Great Oolite Formation	414250	202240	-		-
SP10/5B	H.J.Godwins Works Quenington	38.1	1933	Great Oolite Formation	414330	204360	-		-
SP10/45	E.Of Crossroads Cottages Quenington	30.5	1929	Great Oolite Formation	413700	204100	-		-
SP10/70	Mawley Farm Quenington	76.2	1961	Inferior Oolite Group	413450	203930	-		-
SP10/84	Donkeywell Farm Quenington	106.7		Great Oolite Group	412840	203420	-		-
SP10/54	Donkey Well Buildings	97.5	1973	Inferior Oolite Group	412750	203400	1973	1973	1980
SP10/4	Donkeywell Buildings	45.7		Great Oolite Formation	412710	203410	1963	1963	1980
SP10/23	Honeycombe Leaze Quenington	44.2	1925	Great Oolite Formation	412690	202280	-		-
SP10/102	Homleaze Farm Hatherop	58.0		Great Oolite Formation	417400	204300	-		-
SP10/1	South Farm Quenington	25.6	1935	Great Oolite Formation	417140	203100	-		-
SP10/2	South Farm Southrop	34.1	1954	Great Oolite Formation	417760	202530	1954	1975	1980
SP10/26	Southrop Manor Lechlade	31.7	1949	Great Oolite Formation	419530	202490	1949	1975	1977
SP10/60	Stanford Hall Lechlade	54.9	1946	Great Oolite Formation	419090	202030	-		-
SP10/25	Stanford Hall	54.9		Great Oolite Group	418960	202000	-		-
SP10/65	Waitenhill House Fairford	66.0	1954	Great Oolite Formation	413030	200400	-		-
SU19/3	Marston Hill Farm			Unknown	412940	199800	-		-
SU19/4	Marston Hill Farm	35.1	1949	Multiple Aquifers	412930	199820	-		-
SP10/28B	Magpies Farm, Meysey Hampton	18.3	1930	Great Oolite Group	412840	200370	-		-
SP10/28A	The Three Magpies Marston Maisey	15.2	1930	Great Oolite Formation	412680	200370	-		-
SU19/38	Manor House Meysey Hampton	4.6		River Terrace Deposits	411920	199860	-		-
SU19/32A	The Old Rectory Meysey Hampton	29.3	1935	Cornbrash Formation	411800	199850	-		-
SU19/32B	The Old Rectory Meysey Hampton	21.9	1937	Forest Marble Formation	411730	199900	-		-
SU19/30	Manor Farm Meysey Hampton	27.4	1945	Forest Marble Formation	411700	199970	-		-
SU19/78	The New Rectory Meysey Hampton	28.2	1935	Forest Marble Formation	411650	199990	-		-

B-3 Rainfall Data

Appendix B-3-1 List of Rainfall Stations in the Vicinity of Fairford

RAIN_NO	STN_NAME	EASTING	NORTHING	ELEVATION	FIRSTYEAR	MACHDATA	LAST YEAR	FREQ_OBS
248128	Cirencester, Royal Ag.Coll.	4002	2013	135	1875	1882	1915	
248113	Cirencester	4003	2011	133	1951	1961		daily
248300	Somerford Keynes, Manor Ho.	4016	1955	91	1925		1945	
249124	Stratton	4016	2037	131	1968	1968	1969	
249150	Cirencester, Cripp's Mead	4019	2023	111	1902		1922	
249134	Cirencester, The Firs	4019	2031	107	1870		1884	
249145	Cirencester, Chesterton Grove	4022	2009	123	1956	1957	1986	daily
249142	Cirencester, Somerford Rd	4022	2012	115	1941	1941	1956	
249159	Cirencester, Dollarward Ho.	4022	2021	111	1890		1924	
249147	Cirencester, Chesterton Lane Mter	4026	2010	100	1980	1981	1983	daily
249141	Cirencester, Gwynfa	4028	2017	108	1923	1923	1941	
248332	Shorncote S.Wks Auto.Sta.	4034	1971	94	1993			daily
249175	South Cerney Met.Office	4050	1993	111	1965	1965	1967	
249515	Waterton House	4065	2013	110	1939		1952	
249447	Barnsley	4077	2051	133	1996	1996		daily
250791	Bibury, Furzey Barn Farm Mter	4110	2050	145	1977	1978	1983	daily
250123	Kempsford	4148	1972	79	1863	1875		daily
250849	Fairford	4152	2012	90	1996	1996		daily
250198	Fairford Met.Office	4158	1990	82	1968	1968	1977	daily
250858	Fairford S.T.W.	4158	2003	99	1991	1991	1996	daily
250965	Claydon House	4192	2001	76	1892		1951	
251281	Sevenhampton	4207	1904	91	1990	1990		daily
251529	Lechlade, St John's Lock	4222	1990	72	1913	1913		daily
251530	Lechlade, St John's Lock Auto.Sta.	4222	1990	72	1993			daily
252265	Holwell	4233	2091	130	1969	1971	1973	
252055	Broughton Poggs	4234	2038	84	1920		1950	
251898	Kelmscott	4245	1993	70	1930	1951	1972	
251422	Great Coxwell	4269	1939	116	1952	1958	1975	daily
252460	Brize Norton, Met.Office	4289	2060	84	1968	1968	1969	
252448	Brize Norton Met.Office	4292	2067	81	1969	1970		daily
252449	Brize Norton, Met.Office Sser	4292	2067	81	1971	1979		daily
252450	Brize Norton Samos	4292	2067	81	1995	1995		daily
252473	Bampton	4310	2029	70	1956	1969		daily

Appendix B-3-2 Monthly Rainfall [mm] at Lechlade, 1913-2018

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1913	82.0	26.3	65.7	78.7	46.0	13.0	41.2	18.6	57.3	73.6	53.1	24.8	580.3
1914	9.6	50.1	89.6	21.0	23.3	48.5	80.1	45.6	22.4	52.2	107.4	117.4	667.2
1915	73.7	64.2	26.0	23.1	77.8	22.9	95.8	71.4	40.7	90.5	19.0	109.3	714.4
1916	30.0	92.8	96.8	22.3	46.2	41.2	27.4	90.0	23.9	111.2	69.7	84.0	735.5
1917	27.0	28.5	51.4	27.7	68.7	79.4	72.2	123.9	46.4	88.8	21.0	33.5	668.5
1918	66.3	31.7	21.4	74.5	47.1	17.8	93.4	40.2	112.0	35.2	44.5	57.6	641.7
1919	73.7	58.6	97.6	47.8	19.8	43.3	54.8	61.8	40.4	33.5	30.3	97.7	659.3
1920	54.8	17.6	43.7	117.9	78.4	59.8	115.3	22.5	35.9	65.9	15.3	47.3	674.4
1921	57.3	10.9	24.7	26.4	34.6	10.8	4.6	30.4	40.6	36.4	47.8	34.1	358.6
1922	51.2	67.8	50.3	67.5	25.5	38.3	89.5	103.3	31.8	19.0	34.3	67.6	646.1
1923	33.2	89.4	53.1	48.5	26.6	7.5	38.3	56.5	63.0	101.7	25.9	70.0	613.7
1924-1930 missing													
1931	34.9	44.7	4.1	74.9	113.5	88.6	75.3	75.0	38.8	16.8	81.9	29.1	677.6
1932	52.9	3.1	47.2	66.5	153.2	23.8	76.0	33.0	83.1	118.5	41.3	16.3	714.9
1933	41.8	80.9	70.5	32.8	29.3	52.9	41.7	34.9	82.1	54.4	18.2	11.9	551.4
1934	47.3	4.9	43.5	54.1	18.7	36.9	36.9	35.9	38.4	35.5	43.4	121.6	517.1
1935	13.9	49.3	11.5	87.8	36.9	90.1	17.3	41.0	112.5	112.1	118.4	75.0	765.8
1936	75.1	43.8	47.6	26.7	15.1	51.0	114.4	8.7	63.0	41.0	75.0	65.8	627.2
1937	89.9	116.3	63.2	76.7	63.2	41.4	46.3	13.8	50.6	84.5	31.1	47.7	724.7
1938	71.1	21.3	6.4	1.4	45.7	28.1	42.8	96.0	70.5	80.6	70.7	59.1	593.7
1939	114.9	24.9	36.0	82.6	34.2	48.8	124.2	40.0	40.3	99.1	117.2	44.6	806.8
1940	73.0	50.8	53.6	44.7	47.3	15.3	73.7	2.4	27.7	68.5	182.6	30.0	669.6
1941	73.3	64.6	73.1	25.7	31.4	46.3	55.8	85.1	18.8	37.4	63.2	43.0	617.7
1942	80.1	19.2	53.0	27.3	111.8	5.9	46.4	85.3	41.2	81.5	53.8	92.4	697.9
1943	110.3	23.6	27.0	17.7	65.7	40.9	31.3	56.7	28.8	73.7	42.1	24.7	542.5
1944	42.6	22.9	8.6	46.5	15.7	42.3	54.6	47.2	61.9	88.4	112.3	37.7	580.7
1945	44.7	52.2	22.9	26.8	58.9	84.5	48.5	57.8	40.6	84.9	6.8	92.3	620.9
1946	48.3	59.5	23.4	39.4	89.0	73.9	25.8	128.6	76.7	25.0	125.0	42.8	757.4
1947	36.3	33.9	158.0	61.2	40.6	35.8	58.7	11.3	35.0	9.9	35.9	49.5	566.1
1948	128.8	27.6	23.6	51.5	105.8	42.1	30.6	91.2	51.7	71.3	40.3	88.0	752.5
1949	27.3	24.9	38.2	36.1	63.7	11.0	71.7	44.3	51.4	145.3	75.6	29.0	618.5
1950	11.3	113.3	25.0	50.7	63.7	39.2	99.2	84.2	87.7	15.9	123.3	41.7	755.2
1951	70.7	89.2	96.6	63.4	64.1	30.3	24.1	124.9	77.5	28.6	139.3	51.9	860.6
1952	44.9	12.5	62.5	42.2	69.1	39.7	7.6	134.9	24.9	103.9	96.2	54.5	692.9
1953	18.1	30.3	24.9	42.5	43.1	35.8	65.6	75.8	56.6	74.2	27.0	15.8	509.7
1954	37.0	59.7	61.1	6.9	48.2	92.7	46.0	90.7	56.7	58.9	120.5	47.5	725.9
1955	57.0	39.2	36.4	12.2	103.1	74.1	5.9	16.0	18.2	37.1	34.8	77.4	511.4
1956	88.6	4.2	9.2	43.6	6.2	60.2	55.9	114.6	99.3	54.2	20.7	113.6	670.3
1957	52.0	85.2	58.4	8.5	43.3	39.2	62.8	84.4	77.4	52.0	45.7	48.7	657.6
1958	72.7	84.1	28.8	20.2	63.1	99.4	63.5	82.1	89.5	63.8	68.5	91.0	826.7
1959	101.2	2.1	74.4	67.5	18.3	23.7	47.0	61.0	6.6	41.2	44.1	130.8	617.9
1960	102.3	53.2	30.2	22.7	40.0	94.7	85.8	67.4	95.5	145.2	118.3	104.3	959.6
1961	84.7	71.0	3.1	89.1	28.6	38.4	57.5	43.6	60.5	72.0	33.0	113.4	694.9
1962	92.3	10.7	35.6	55.7	53.0	7.4	53.2	103.3	95.6	21.3	54.0	61.4	643.5
1963	28.8	8.3	94.2	64.0	44.9	90.9	45.0	68.7	47.2	49.9	133.3	23.6	698.8
1964	16.3	26.0	91.1	61.1	68.2	65.7	21.3	19.0	23.9	33.7	44.7	54.6	525.6
1965	66.3	4.1	55.0	44.6	77.7	71.2	76.2	46.3	82.5	15.8	75.3	122.1	737.1
1966	39.7	106.1	12.5	100.4	50.6	42.4	68.6	82.8	42.7	148.0	42.6	76.2	812.6
1967	42.9	93.5	40.9	34.2	124.4	40.5	43.2	51.3	73.8	150.3	35.8	68.0	798.8
1968	69.4	31.9	23.7	60.2	64.9	95.7	141.3	67.5	109.2	65.4	51.3	71.4	851.9
1969	59.7	45.7	54.5	29.3	122.8	18.5	46.6	91.6	29.2	7.8	60.4	61.5	627.6
1970	65.8	43.2	46.3	58.1	28.4	63.5	53.7	108.9	42.7	22.0	126.8	27.8	687.2
1971	111.3	24.3	43.1	69.1	44.2	122.7	6.3	74.6	22.2	91.8	56.8	31.7	698.1
1972	55.7	55.6	59.8	55.6	76.7	34.1	32.7	14.1	32.4	20.7	46.1	85.7	569.2
1973	27.4	15.1	11.4	51.5	53.8	98.0	70.1	28.4	43.2	28.2	29.5	31.2	487.8
1974	79.1	76.7	31.5	7.5	24.8	51.7	33.4	78.5	117.6	49.8	69.4	36.8	656.8
1975	80.1	37.6	73.9	30.7	30.0	10.7	55.7	26.1	87.1	13.0	38.5	23.2	506.6
1976	18.4	19.1	24.2	10.1	31.2	22.6	53.7	26.9	104.5	106.7	51.2	85.5	554.1

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1977	64.5	114.3	51.9	37.2	42.8	102.9	8.1	147.2	11.6	35.0	47.9	62.1	725.5
1978	63.1	38.8	44.2	45.9	24.5	31.3	89.9	30.2	19.8	4.4	20.6	99.4	512.1
1979	40.3	42.9	87.8	41.6	118.2	37.3	13.5	71.5	13.8	44.7	49.4	110.5	671.5
1980	36.3	46.4	80.9	17.2	19.6	87.1	52.2	80.8	60.6	62.2	41.8	36.2	621.3
1981	30.1	20.6	114.1	30.8	84.9	40.4	47.4	40.2	113.8	67.8	35.9	84.4	710.4
1982	54.5	39.3	82.2	25.8	13.4	72.8	27.7	33.5	64.1	75.8	84.7	61.5	635.3
1983	45.8	14.0	42.2	82.4	103.0	15.3	47.1	15.3	54.7	42.1	35.6	52.4	549.9
1984	97.7	30.2	38.5	1.0	76.5	25.2	12.5	27.0	74.9	48.9	127.4	45.8	605.6
1985	46.0	43.0	55.6	25.7	105.9	107.7	40.9	94.1	13.6	31.8	37.9	100.9	703.1
1986	72.6	7.8	57.8	60.5	64.7	16.1	33.6	77.5	30.9	65.0	86.8	69.5	642.8
1987	10.4	48.5	57.0	57.3	35.6	98.2	36.4	30.6	38.0	138.7	63.4	34.1	648.2
1988	100.1	42.4	53.8	27.8	43.3	55.2	96.7	50.4	43.1	55.3	27.0	14.6	609.7
1989	30.8	61.5	46.8	64.0	9.5	37.5	37.8	38.7	34.7	71.2	45.2	129.6	607.3
1990	62.6	83.0	15.9	26.5	5.3	41.4	17.1	29.5	31.4	49.7	26.3	59.7	448.4
1991	69.5	21.5	62.1	55.3	9.8	79.7	62.5	2.0	55.5	38.6	62.5	12.9	531.9
1992	32.6	22.4	38.8	48.4	45.0	35.3	97.4	101.8	85.2	65.0	131.8	53.5	757.2
1993	73.9	4.1	27.3	58.9	126.7	49.0	55.1	26.9	59.1	89.0	36.2	94.3	700.5
1994	85.3	58.4	38.5	43.2	83.9	12.9	34.7	39.9	64.3	55.4	51.9	76.6	645.0
1995	110.7	72.2	36.5	20.0	46.5	8.3	13.2	1.1	142.2	48.9	61.7	98.4	659.7
1996	33.4	58.3	33.5	51.3	27.7	32.2	24.6	71.3	24.2	42.7	67.7	21.1	488.0
1997	7.2	70.2	10.9	22.9	52.1	64.3	15.2	105.5	12.2	50.3	75.7	65.6	552.1
1998	67.7	9.7	63.1	109.7	45.2	98.1	24.0	27.4	-	113.4	60.1	73.9	692.3
1999	104.9	26.6	32.3	53.4	68.8	79.2	2.7	97.9	96.3	58.7	42.9	84.4	748.1
2000	18.6	75.2	14.2	147.3	82.0	41.7	23.8	64.4	92.7	110.4	97.7	109.8	877.8
2001	58.7	71.5	75.7	77.3	33.3	28.2	58.7	96.6	20.2	69.4	33.4	20.3	643.3
2002	67.4	77.6	35.2	47.1	66.7	50.5	131.0	37.3	16.7	126.2	116.8	101.7	874.2
2003	71.8	20.4	25.3	38.7	55.7	38.2	64.2	11.7	14.3	27.4	86.5	78.5	532.7
2004	77.3	30.6	43.7	74.1	47.6	35.9	46.4	140.6	34.4	127.1	34.2	52.0	743.9
2005	28.7	17.8	55.9	56.5	38.1	56.6	54.8	40.8	40.9	65.8	51.3	61.4	568.6
2006	19.9	31.8	71.7	30.3	94.6	8.4	74.1	32.8	117.4	66.1	113.3	89.2	749.6
2007	90.5	82.9	55.7	3.5	111.8	107.8	176.1	43.6	20.1	83.4	51.3	89.9	916.6
2008	106.9	21.6	73.9	33.7	106.8	84.3	118.0	91.2	82.3	38.3	80.0	39.4	876.4
2009	58.9	-	22.9	43.5	40.1	47.2	84.1	60.2	7.4	54.3	117.7	74.4	610.7
2010	67.0	54.7	49.7	23.2	27.6	27.2	23.4	128.0	32.3	46.8	55.6	25.2	560.7
2011	56.0	-	11.0	2.9	32.1	51.4	37.5	52.2	40.9	30.4	30.9	91.7	437.0
2012	50.8	27.7	22.9	123.1	50.5	151.6	75.3	95.4	66.8	84.5	114.3	129.5	992.4
2013	81.2	38.9	65.8	24.1	56.0	20.9	37.0	20.3	48.5	96.1	54.8	118.5	662.1
2014	157.1	105.8	30.0	58.5	Data missing		25.4	75.4	20.3	67.5	97.1	56.9	694.0
2015	79.3	41.4	21.6	17.1	59.2	22.7	75.0	57.7	32.4	46.3	92.3	-	545.0
2016	74.2	65.3	75.9	71.9	-	74.4	11.3	58.4	45.2	14.4	91.7	21.6	604.3
2017	69.1	31.3	40.2	6.5	72.6	29.0	79.6	41.4	47.6	21.9	52.2	97.3	588.7
2018	**66.1**	25.8	93.5	**50.8**	**62.4**							Data missing	298.6
min	7.2	2.1	3.1	1.0	5.3	5.9	2.7	1.1	6.6	4.4	6.8	11.9	**358.6**
max	157.1	116.3	158.0	147.3	153.2	151.6	176.1	147.2	142.2	150.3	182.6	130.8	**992.4**
Mean	**60.6**	44.8	47.4	**46.2**	**55.8**	50.0	54.0	60.3	53.2	62.6	64.1	64.9	**659.6**

Appendix B-3-3 Monthly Rainfall [mm] for Thames Model Cotswold West Area

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1920	96.4	26.9	80.1	144.4	63.9	81.7	135.5	40.2	50.1	84.2	24	73.9	901.3
1921	73.8	9.3	40	30	50.9	7.5	11.1	59.8	46.6	38.4	57.8	47.4	472.6
1922	91.6	94.9	65.9	94.9	22.6	27.6	128.3	136.3	58.1	22.2	50.3	107.5	900.2
1923	51.6	155.3	61.6	72.4	45.2	9	60.2	63.7	76	144.8	53	94.3	887.1
1924	103.6	18	34.9	92.4	181.5	68.3	117.3	81.5	138.2	129	69.8	123	1157.5
1925	51.5	112.5	15.2	53.4	102.8	3	93.2	76.4	108.9	89.8	47.7	77.5	831.9
1926	114.4	62.6	17.1	94.2	100.2	67.8	66.5	40.1	37.4	73.6	185.9	14.5	874.3
1927	90.2	100	87.9	51.6	38.6	94.1	94.7	115.9	162.1	47.8	76.4	92.1	1051.4
1928	122.2	64.2	68.1	26.3	22.3	74	70.6	65.7	24.6	142.5	92.1	77.3	849.9
1929	33.1	16.9	2.1	34.2	59.4	35	39.7	49.7	12.7	118.9	215.6	200.8	818.1
1930	131.4	13.8	49.1	85.2	43.9	56.6	94.7	72.8	101.8	52.8	116.9	100.9	919.9
1931	47.4	64.4	5.3	95	117.2	96.9	100.3	123.5	61	20.5	114.9	36.9	883.3
1932	75.7	3.6	55.6	81.8	166.9	33.1	65.5	78.2	88.2	126.4	51.9	25	851.9
1933	63.4	104.4	80.2	32.1	47.1	51.9	42.1	23.5	65.9	73.1	27.6	13.3	624.6
1934	67	10.8	62.9	69.3	20.7	48	30.4	51	63.1	42.6	49.9	175.1	690.8
1935	21.8	71.6	12.2	121.6	50.2	99.3	19.9	44.1	134	123.8	158.4	103.2	960.1
1936	102.8	62.1	61	55.7	19.8	89.4	153.4	12.9	128.4	39.3	76.9	87.7	889.4
1937	111.9	131.3	96.8	91.7	66.5	49.1	57	18	49.7	94.1	39.8	62.3	868.2
1938	89	23.1	8.4	2.5	53.7	34.3	61.5	90.7	74.7	98.6	89.5	100.1	726.1
1939	160.3	39.5	51.9	89.2	29.1	62.3	128.1	55.9	33.2	113.6	126.3	55.8	945.2
1940	77.2	60.6	64.2	48	50.5	18.1	93.6	2.7	31.5	113.4	196.1	41.7	797.6
1941	81.3	84.4	78.9	28.9	51	64.8	91.8	117.4	18.3	54.5	73.5	54.1	798.9
1942	96.3	20.1	58.8	34.5	116.5	8.5	56.1	115.3	43.9	86.6	55.5	110.3	802.4
1943	142.9	35.6	27	22.5	82.1	55.5	22.6	61.7	52.1	70.2	48.7	32.6	653.5
1944	55.4	28.1	8.5	43.5	35.9	68.5	68.5	65.5	82.7	119.3	130.1	61.8	767.8
1945	54.9	62.6	28.3	31.9	66.1	82.2	41.3	50	44.1	91.8	8.5	116.6	678.3
1946	64.2	64.8	25.1	50.3	88	74.7	31.8	153.2	108.3	22.5	163.5	68.3	914.7
1947	54	40.4	168	67.7	46	42.4	71.2	13.3	53.9	11.6	38.9	54.6	662
1948	146.5	29.9	32.3	64	115.2	66.5	27	106.2	73.6	86.9	34.3	107.8	890.2
1949	33.9	37.6	44	49.4	72.5	14.7	33.7	29.5	67.1	151.5	82.1	34.1	650.1
1950	12.2	150.1	35.5	58.6	74.1	51.4	97	105.2	106.2	17	151.8	44.4	903.5
1951	87.9	110.2	115.1	89.6	81.1	27.4	36.7	147.3	92.7	26.3	188.3	67.1	1069.7
1952	60.9	18.8	79.3	58.1	76.4	46.7	8.7	123.7	32.3	115	111.2	79.1	810.2
1953	28	49	31.4	60.2	60.9	59.9	95.7	92.8	71.9	76.3	28.5	22.5	677.1
1954	38.1	70.8	73.9	9.2	64.1	109.6	65	110.7	90.9	82.1	163.2	62	939.6
1955	69.2	44.8	46.6	27	122.1	91.9	5.6	13.4	28.9	44.5	68.2	81	643.2
1956	113	10.7	18.4	49.1	16.8	64.8	53.8	134	87.6	49.7	24.6	109.1	731.6
1957	63.9	91.7	70.3	9.7	36.6	48.4	103.3	135.3	108.6	54.9	51.3	68.5	842.5
1958	85.2	101.5	36.1	22.3	80.3	99.9	76.4	78.9	100.5	74.9	83.3	90.3	929.6
1959	119.6	2.8	83.9	80.4	33.5	33.6	46	43.7	4	55.2	66.2	153.5	722.4
1960	123.2	66.6	37.4	22.6	56.4	92.5	111.5	90.3	122.1	155.1	123.5	105.4	1106.6
1961	88.9	65.2	4.2	122.8	28	38.3	71.2	55.4	63.5	76.2	32.2	108.6	754.5
1962	101.7	13.4	31.1	64	58.5	6.1	36.3	135.9	83.6	25.1	69.2	64.3	689.2
1963	31.2	15.8	98.2	63.4	41.9	99.6	54.9	82.2	53.6	47	148.7	26.9	763.4
1964	19.9	28.7	80.1	59.4	61.5	65.3	24.6	18.9	19.9	36.2	45.1	77.5	537.1
1965	79.8	7.8	63.8	50.5	61.6	73.7	100.2	42.4	107.3	15.8	74.4	148.6	825.9
1966	43.7	98.8	23.4	93	63.2	42.4	61.5	86.4	30.3	115.7	51.4	93.2	803
1967	52.3	95.8	57.6	29.8	159.6	31.2	40	53.4	95.5	163.9	50	81.2	910.3
1968	71.3	41.8	29.9	66.9	73.9	110.8	123	59	134.4	71	62.5	89.5	934
1969	75.8	54.3	60.6	43.4	124	32.9	64.1	96.8	27.7	10.5	80.6	79.2	749.9
1970	93.6	59.7	53.7	67.4	36.9	74.4	68.4	86.5	61	24.6	161	36.3	823.5
1971	128.9	25.6	61.3	56.7	52	123.6	35.1	102.5	17.5	86.3	73.6	35.2	798.3
1972	86.5	79	73.9	52.6	74.6	49.9	33.1	24.6	37.4	31.1	58.4	138.1	739.2
1973	36.8	21.8	17.4	64.7	64.4	85.8	89.7	39.3	51.8	30.3	35.2	39.9	577.1
1974	109.4	111.8	36.7	8.2	32.5	55.1	52.5	97.1	139.5	56.9	92.3	49.8	841.8
1975	99.9	42.3	103.1	41.3	29.1	9.8	54.9	33	81.5	17.6	46.6	36.4	595.5
1976	23.9	31.8	33	12.4	40.5	25.8	19	38.1	135.2	111.6	54.7	100.9	626.9
1977	80.5	142.9	70.3	42.4	49	125.7	10.6	161.7	16.3	46.8	70.2	87.2	903.6

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1978	93.1	54.4	66	50.9	26.8	40.2	109.8	59.4	28.5	6.7	29.1	145.9	710.8
1979	66	56.9	133.4	48.3	140.6	31.4	22.6	78.5	26.3	47.9	64.2	149.6	865.7
1980	63.7	66.8	100.3	22.1	28.6	98.7	60.2	74.2	72.5	83.3	56.1	57.7	784.2
1981	36.3	33.7	137.2	51.9	97.5	29.9	38.6	44.5	150	80.1	43.6	99.5	842.8
1982	63	45.9	102.2	27.4	25.4	108.3	39.8	55	90.2	90.8	99.9	84.4	832.3
1983	70.6	19.9	52.3	92.5	128.4	14.3	65.9	21.9	82.1	52.1	49.6	66	715.6
1984	114.6	45.4	47.2	6.1	66.8	25.4	11.5	56.5	113	78.2	152.9	60.9	778.5
1985	60.3	46.6	64	42	86.5	143.6	54.3	92	20.2	60.8	51.9	111.3	833.5
1986	102.9	9.4	67.2	70.3	84.6	30.7	45.1	118.5	22.7	73.5	108.5	92.6	826
1987	11.3	49.4	73.5	59.6	44.4	111.2	58.2	32.2	37.5	152.4	78.8	41	749.5
1988	129.6	49.8	79.7	34.6	48	41.1	115.5	70.5	46.7	69.1	32.5	19	736.1
1989	37.3	81.9	66.3	81.2	19.7	44.7	32	54.2	52.8	103.7	50.1	145.6	769.5
1990	98.2	122.5	14.5	35.4	5.6	61.6	28.4	27.8	39.5	63.8	31.9	81.7	610.9
1991	89.4	35.2	70.3	68.4	12.8	105.2	81.7	11.7	56	55.5	93.7	18.8	698.7
1992	68.5	31.3	52.9	71.3	58.2	56.8	98.3	129.9	77.8	69.5	138.4	71.2	924.1
1993	115.9	10.5	27.9	81.3	95.3	59.9	73.7	31.4	97.2	90.5	57.6	134.5	875.7
1994	110.9	75.2	64.3	51.3	90.7	22.5	27.2	48.5	96.7	72.1	67.4	115.9	842.7
1995	143.6	92.4	46.4	23	61.5	10.7	22.8	3.2	126.2	64	82.2	102.1	778.1
1996	51	67.8	47.7	53.4	40.6	17.6	38.7	68.2	27.2	60.5	84.1	36.3	593.1
1997	8.3	98.4	14.9	27.5	77.4	83.1	29.4	124.8	24.1	68.6	102.1	87.6	746.2
1998	96.8	12.1	86.3	120	29.3	109.9	23.6	35.2	106.4	135	70.2	83.4	908.2
1999	141	34.5	53.3	82.1	85.7	66.2	5.9	112.6	118.5	73.5	52.8	127.4	953.5
2000	29	90.8	21.8	171.3	83	32.5	41.7	56.6	107.7	154.3	143.6	146.4	1078.7
2001	67.4	82.8	93.2	108.9	41.4	29.6	71.9	76.6	53.2	116.5	46.2	29	816.7
2002	91.8	119.2	44.2	47.2	84.6	56.5	92.6	35.7	24.6	155.3	132.2	113.8	997.7
2003	81.9	25.6	36.1	49.9	59	49.1	84.8	10.3	19.7	42.7	97	92.5	648.6
2004	101.9	32.4	56.3	88.2	47.7	44	53.3	136.8	49.7	148	45	46.8	850.1
2005	35.8	26.7	66.3	58.3	44.4	40.8	47.5	39.7	53.2	94.7	81.7	76.4	665.5
2006	21.4	34.4	84.2	30.1	121.1	14.7	72.9	61.7	112.8	88.4	112.7	119.8	874.2
2007	91.7	98.1	74.7	5.1	142.8	129.3	201.4	45.9	31.7	74.2	96.8	83.6	1075.3
2008	121.8	31.6	100.1	47.8	96.4	61.6	131.5	104.5	116.1	49.5	83.6	54.7	999.2
2009	77	60.3	30.2	42.5	50.7	55.8	99.6	75	26.8	67.2	159.2	87	831.3
2010	90.2	54.9	61.7	24	42.9	38.2	31	134.8	45.8	60.6	62.1	35.5	681.7
2011	65.8	64.8	10.4	4.9	44.9	57.9	45.9	52.7	40.7	38.9	39.1	96.4	562.4
2012	55.6	24.6	26.5	139	51.2	159.1	105.1	109.4	72.8	100.1	148.6	153.1	1145.1
2013	82.7	44.9	75.3	29.1	75	27.9	38.9	30.9	56.6	145.5	65.5	135.5	807.8
2014	210	164.4	43.7	58.2	70	27.7	36.2	99.3	5.5	90.1	95.7	45.9	946.7
2015	85.5	52.9	27.8	15	61.4	37.7	69.3	62.9	41.2	63.3	92.8	117.1	726.9
2016	108.5	74.9	97.8	47.9	65.8	65.5	13.8	41.3	50.3	15.9	96.7	31.4	709.8
2017	75.4	41	51.6	11	62.7	69.4	74.1	53.7	62.6	33	56.1	107.9	698.5
2018	**77.5**	32.7	113.6	**55.6**	**82.5**	2.9	-	-	-	-	-	-	364.8
min	8.3	2.8	2.1	2.5	5.6	2.9	5.6	2.7	4.0	6.7	8.5	13.3	364.8
max	210.0	164.4	168.0	171.3	181.5	159.1	201.4	161.7	162.1	163.9	215.6	200.8	1157.5
avg	**79.5**	56.6	56.6	**55.7**	**65.3**	57.3	62.7	70.2	67.1	75.4	82.4	82.0	806.3

Appendix B-3-4 Monthly Areal Infiltration [mm] for Thames Model Cotswold West Area

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1920	83.4	11.7	41.5	99.5	4.9	6.4	26.4	2.7	5.2	40.3	13.2	65.2	400.4
1921	61.4	2.3	5.4	2	3	0	0	3.9	5.1	4.5	7.8	6.2	101.6
1922	51.9	81.6	37.7	43.8	2.4	0.7	13.2	34.8	13.3	2	41.9	99.6	422.9
1923	46.7	142	37.9	35	1.4	0.4	4.9	5.5	8.6	76.3	49.1	90.7	498.5
1924	99.5	1.8	11.2	30.1	106.3	28.2	10.5	6.2	87.4	105.5	58.6	116.9	662.2
1925	42.7	96.6	1.1	3.6	8	0	9	5.9	26	62.9	44.2	74.5	374.5
1926	106.6	49.2	1.4	19.6	41.9	4.7	4.8	2	3.4	9.4	159.2	11.8	414
1927	81.8	88.6	47.1	25.6	1.5	7.2	7.3	28.9	109.1	26.2	69.8	86.5	579.6
1928	114.6	52.4	33.1	4.3	0.7	4.4	7.6	5	2.6	38.4	80.6	74.3	418
1929	28.5	10.6	0	2.5	4.8	1.2	2.4	3.3	0.8	15.9	174.1	188.9	433
1930	121.2	7.2	28.5	29.5	1.7	5.1	8.2	5.5	11.7	19.8	105.4	95.5	439.3
1931	45.6	51.5	0	16.4	32.8	26.6	8.4	58.1	13.7	2.3	96.8	31	383.2
1932	73.3	0.3	12.8	25.7	105.8	3.5	5.4	9.7	19.7	101.5	40.3	21.4	419.4
1933	63	93.5	54.6	2.8	3.2	2.8	2	1.5	7.7	9	3.8	1.8	245.7
1934	50.4	4.1	41.8	15.1	1	3.8	1.2	3.5	6.4	4.4	7.3	129.6	268.6
1935	15.6	51.3	2.1	51.5	3.8	6.5	0.9	3.7	14.8	88	151.4	100	489.6
1936	95.2	50.1	32.7	12.1	0.6	8.6	26	0.1	51.8	10.3	69	80.9	437.4
1937	105.7	116.4	74.3	46.2	4.9	3.4	6.2	1.1	4.6	13	33	60.4	469.2
1938	76.5	6.4	1.8	0	4.2	1.7	4.9	9.1	8.7	30.4	79.3	97.3	320.3
1939	152.3	27.3	21.4	33	2.1	3.9	11.1	5.3	3.4	56.9	115.5	51.6	483.8
1940	76.5	50.6	36.2	2.7	2.2	0.1	6.8	0	1.6	14.6	162.6	36.9	390.8
1941	78.5	74.3	52.6	10.5	2.9	6.5	5.7	9.2	1.2	6.1	58.8	49.2	355.5
1942	90.1	13	35.8	13.7	9.1	0	3.2	11.6	4	43.9	53.5	104.4	382.3
1943	137.6	29.8	3.2	0.4	7.5	2.3	0.3	4.3	4.6	9.2	6.4	16.3	221.9
1944	48.4	17.1	0.5	4.5	2.3	5.3	5.5	6.4	9.3	81.3	123	60.6	364.2
1945	51.2	55	2.2	2.9	5.1	6	2.3	3.5	3.2	13.7	2.8	114.4	262.3
1946	61.9	50.5	7	4.8	9.1	4.8	1.3	44.6	73.4	2.5	144.7	68.3	472.9
1947	51.2	35	148	24.6	3	1.9	3.9	0.6	5.7	1.1	5.4	7.5	287.9
1948	115.2	21.5	3.7	6.2	12.4	9.5	1	11.2	19.2	44.9	31.2	107.4	383.4
1949	28.3	24.6	25.2	4.8	5.7	0.5	2.7	1.9	8.2	40.5	72.9	30.2	245.5
1950	7	140	10.4	4.3	8	3.4	9.5	8.9	41.7	2.2	142.3	43.9	421.6
1951	84.4	99.3	88.2	56.7	6.2	0.8	2.3	15.9	40.5	5.8	180.5	56.7	637.3
1952	57.9	13.3	45.7	18.6	20.7	3.3	0	12.8	1.8	46.1	107.5	79	406.7
1953	25.4	43.2	3.4	10.6	5	4	7.6	9.6	8.3	51.7	20.3	21.7	210.8
1954	34.7	64.1	45.8	3.4	5.4	34.5	4.5	24.3	29.7	62.2	160.1	59.8	528.5
1955	66.8	38	19.6	2.1	21.6	41.4	0.1	0.2	1.9	5.2	9.6	49.9	256.4
1956	109.2	6.2	5.5	5.2	0.6	4.7	4	13.2	34.2	24.1	17.1	107.6	331.6
1957	60.1	85.3	42.7	0.7	2.6	3.6	9	31.6	56.6	34.2	48.9	67.9	443.2
1958	83.5	88.6	10	5.8	6.6	13.7	5.6	6.9	45.3	57.3	79.9	90.3	493.5
1959	119.6	0.2	52.4	30	2.2	0.8	3.8	4	0.3	6.6	9.6	118.4	347.9
1960	122	57	9.3	5	5.7	9.1	11.4	13.9	80.8	139.4	120.3	105.4	679.3
1961	83.7	55	0	49.4	4.3	4	6.8	4	7	9.3	10.7	108.6	342.8
1962	96.5	5.8	3.5	17.6	4.1	0	1.8	15.5	9.3	4.6	64.9	64.1	287.7
1963	30.8	12	67.9	24.7	1.5	7.7	3.9	7.3	5.4	6.1	140.7	26.5	334.5
1964	17	15.7	61.5	4.7	5.3	14.2	0.6	0.5	1.5	4.1	6.3	42	173.4
1965	76.2	0.4	33.7	4.7	4.9	6.5	17.5	3.1	39.9	1.6	63.5	148.5	400.5
1966	41	87.6	6.7	37.7	14.4	1.9	4.3	8.8	2.5	37.8	42.9	86.6	372.2
1967	50.8	81.8	33.2	2.2	56	2.3	1.9	3.6	10.1	107.7	48.2	81.2	479
1968	65.2	36.7	2	6.6	5.8	15	67.2	4.7	54.9	50.5	57.5	88.6	454.7
1969	70.1	44.3	43.6	3.3	34.3	1.5	6.9	9.6	2.6	0.8	36.3	75.3	328.6
1970	91.4	48.4	19.6	21.6	2.3	6.9	4.6	9.2	6.3	2.3	105.3	33.9	351.8
1971	125.6	15.3	36.2	6.9	3.7	38.9	1.4	10.4	1.5	26.6	68.2	29.6	364.3
1972	81.6	65.4	41.1	15.7	5.5	2.3	1.6	1.5	4.8	3.8	8.1	105.7	337.1
1973	33.6	13.8	2.9	6.1	4.1	10.3	13.5	3.8	5.3	3.6	6.5	36.4	139.9
1974	95.9	96.7	20.4	0.2	1.6	4.7	3.7	9.5	15.9	31.3	82.7	37.7	400.3
1975	86.3	37.5	72.3	4.7	1.7	0.3	4.3	0.7	9.2	1.7	6.7	5.2	230.6
1976	3	3.8	3.5	0.7	1.7	1.5	0	4	16.9	31.5	49.1	100.6	216.3
1977	76.2	130.9	37.4	2	3.5	48.1	0.1	48.2	1.2	5.1	45	80.7	478.4

YEAR	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1978	85.3	40.8	25.7	6.1	1.2	2.1	12	4.8	2.1	0	4	111.9	296
1979	63.9	45.7	103	9.7	44.9	1.5	1.7	7.5	2.3	5.6	8.7	133.2	427.7
1980	62.7	57.4	66.7	7.6	1.4	7.3	4.7	7.4	8.2	15.9	39.1	50.1	328.5
1981	30.7	17.4	103.3	7.2	29.6	5	2.1	5.1	35.8	56.8	31.2	97.8	422
1982	59.2	31.8	77.7	2.8	0.4	8.3	3.3	3.6	10.8	25.9	91.1	79.3	394.2
1983	55.1	6.4	20.3	40.9	63.7	0.1	6.8	1.1	8.6	5.9	7.2	53.1	269.2
1984	106	32.6	16.2	0	5.8	1.4	0	3.8	13.2	9.8	119.6	60.9	369.3
1985	56.4	39.1	31.5	11.8	8.7	48.7	4	6.8	1.7	8	28.2	104.9	349.8
1986	93.8	6.8	22.8	30.6	7.2	2.3	2.8	13.5	2.7	9.7	95.3	84.8	372.3
1987	8.6	36.1	41	34.5	2.6	9.9	4.6	1.3	2.4	63.9	70	33.4	308.3
1988	121.8	45	34.7	2.6	2.8	2.4	10.3	6.2	4.4	8.8	22.7	13	274.7
1989	31.2	65.5	40.6	33.2	1.3	2.9	2.5	4.8	5.8	13.6	7.5	130.9	339.8
1990	88.7	99.1	1.1	1.8	0	4.5	1.8	1.5	3.5	7.8	4.4	11.9	226.1
1991	63.8	26.4	50.2	7.1	0.7	8.4	7.9	0.1	5.9	6.6	62.1	14	253.2
1992	63.2	18.6	5.7	17.6	5	5	10.1	13.5	21.1	44.7	126.5	69.4	400.4
1993	102.9	1.2	2.8	29	9.7	3.9	5	2.4	11.6	57	43.3	124.3	393.1
1994	103	64	19.3	23.4	7.6	0.8	0.8	3.3	10.3	9.6	49.7	109.3	401.1
1995	133.6	76.8	22.8	1.7	5.2	0.1	0.8	0	15.4	8.7	35.4	99	399.5
1996	46	54.8	24.1	5.8	2.2	0.5	1.2	5.6	2.7	6.8	11.2	6.9	167.8
1997	7.5	79.6	0.7	3	5.6	6.2	1.2	13.2	1.6	8.8	68.4	80.7	276.5
1998	89.5	1.3	49.5	71.2	1.7	9.1	0.6	2.3	11.6	55	59.9	78	429.7
1999	129.4	18.2	24.9	29.6	11.4	8.1	0	11.4	14	40.2	36.2	116.6	440
2000	23.9	69.6	6.7	101.6	7.6	1.7	1.9	3.7	12.3	108.7	128.9	140.1	606.7
2001	64.6	73.8	67.5	56	2.7	1.7	6	5.6	3.9	14	23.7	26.1	345.6
2002	84.9	98.3	22.6	3.9	6.2	4.5	8.8	1.9	2.6	63.5	119.3	108.8	525.3
2003	73.2	16.6	27.2	3.9	3.1	3.5	6.3	0.3	1.2	5.5	13.6	54.1	208.5
2004	90.5	26.9	16	18.6	16.5	3.8	4.5	12.6	3.4	51.7	32	42.9	319.4
2005	20.3	11.7	36.2	9.6	3.1	2.2	3.6	2.6	5.1	11.9	19.4	72.3	198
2006	18.4	24.3	45.9	2.1	19.7	0	6.3	4.1	13.3	10.2	92.1	110.2	346.6
2007	79.1	80.2	52.2	0	19.5	41.2	109.3	3.4	3	13.6	80.1	76.1	557.7
2008	107.6	21.9	53.7	3	9.7	13.7	20.2	17.1	76.4	5.5	58.6	54.7	442.1
2009	74	57.3	11.1	2.9	3.1	4.6	7.8	7.5	3	7.7	97.4	86.6	363
2010	90.2	49.4	29.1	10.7	3.7	2.6	1.4	14.7	4.3	6.9	18.4	35.2	266.6
2011	64.9	59.1	0.7	0	3.5	3.7	2.8	4	2.1	4	4.9	13.4	163.1
2012	36.8	17.5	11.2	63.6	17	49.7	40.4	9.4	21.9	71.2	140.9	151.3	630.9
2013	79.6	41.4	55.3	2.1	5.9	0.8	2.8	1.3	5.8	18.4	50.5	126.6	390.5
2014	202.9	146.3	13.2	5.6	4.5	1.3	2.2	10.1	0.1	10.6	44.7	41.7	483.2
2015	75.5	44.4	3.3	0.3	4.6	3.2	4.8	5.6	4	8.3	19.5	102.3	275.8
2016	103.5	64.3	64	13	5.9	3.5	0	3.3	4.8	1.7	13.9	16.4	294.3
2017	69.4	28.2	27.6	0.5	5.2	5.7	6.7	3	5.5	3.6	7.8	92.7	255.9
2018	**72**	24.9	75.1	20	8.8	0	-	-	-	-	-	-	200.8
min	3.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	2.8	1.8	101.6
max	202.9	146.3	148.0	101.6	106.3	49.7	109.3	58.1	109.1	139.4	180.5	188.9	679.3
avg	**72.6**	45.7	30.5	16.4	10.1	7.3	7.3	8.2	14.7	26.8	59.1	71.9	368.6

Note: The Cotswold-West model cell is generally referenced as 6010 in Environment Agency water resources situation reports for the Thames region.

B-4 Hydrological Analysis

Figure B-4-1 Cinder Lane annual maxima, 2002-2018

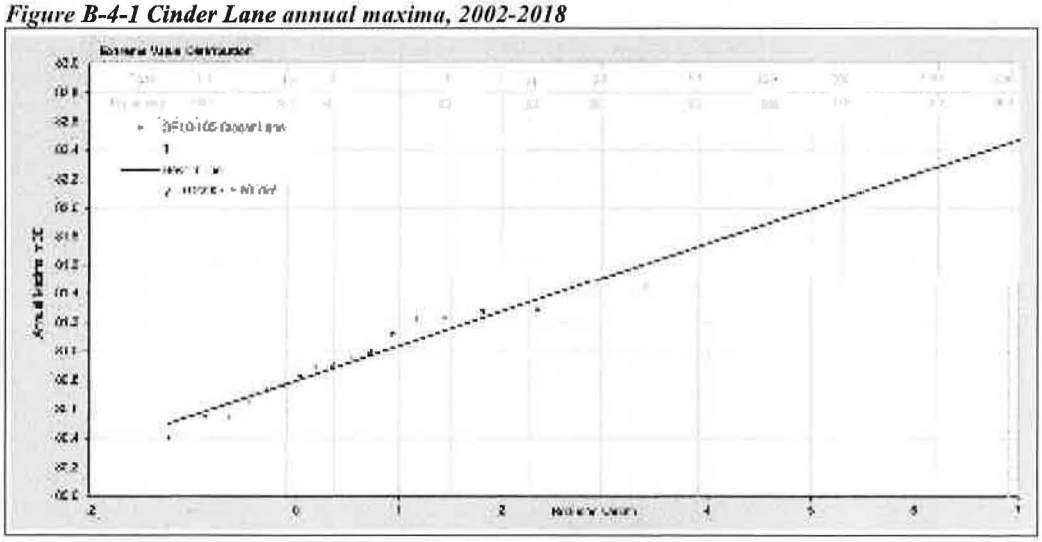
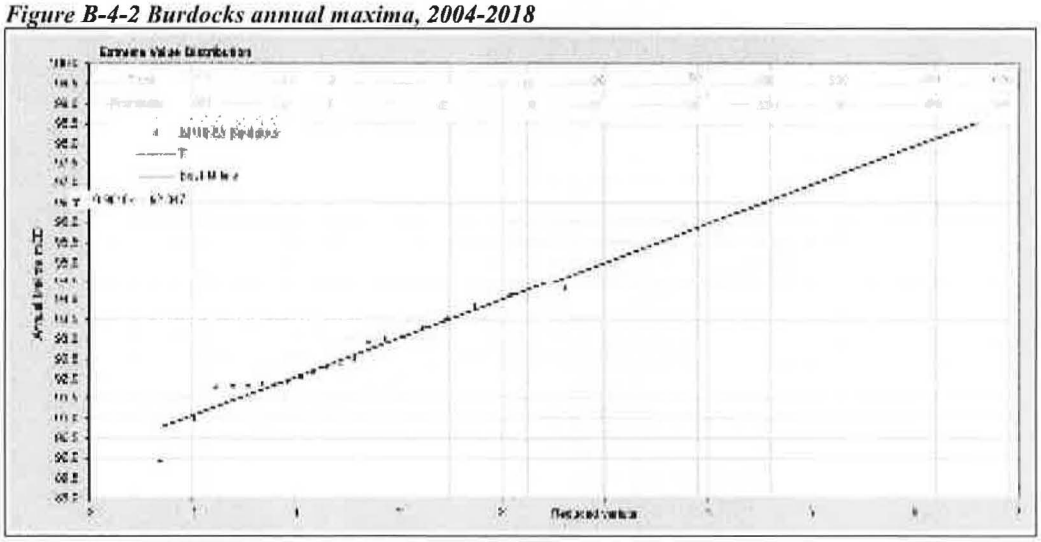
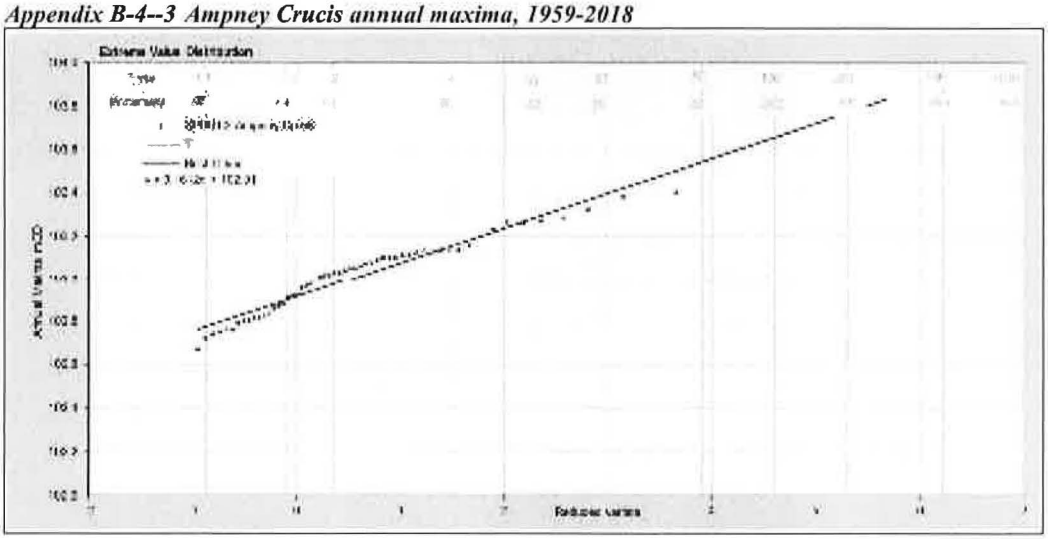


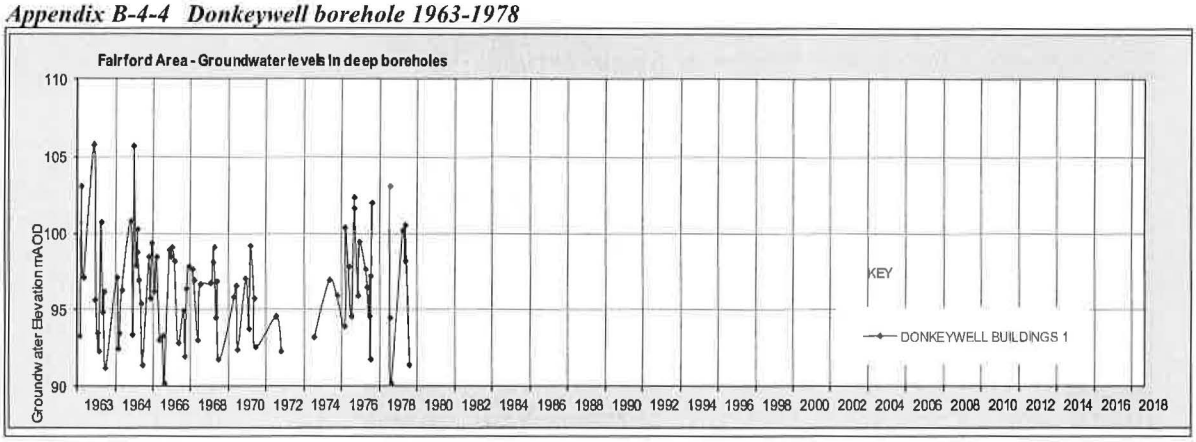
Figure B-4-2 Burdocks annual maxima, 2004-2018



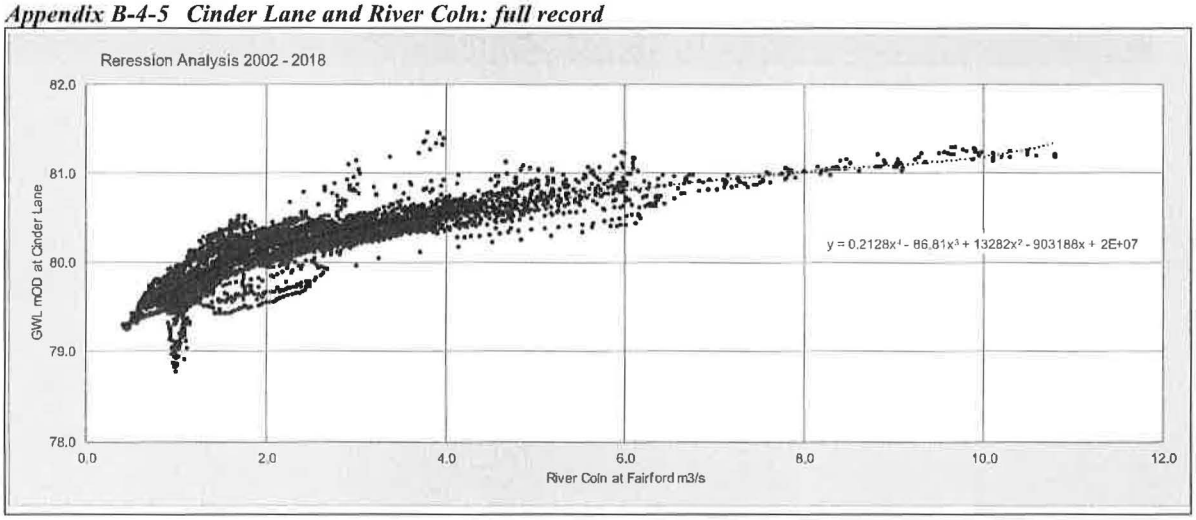
Appendix B-4--3 Ampney Crucis annual maxima, 1959-2018



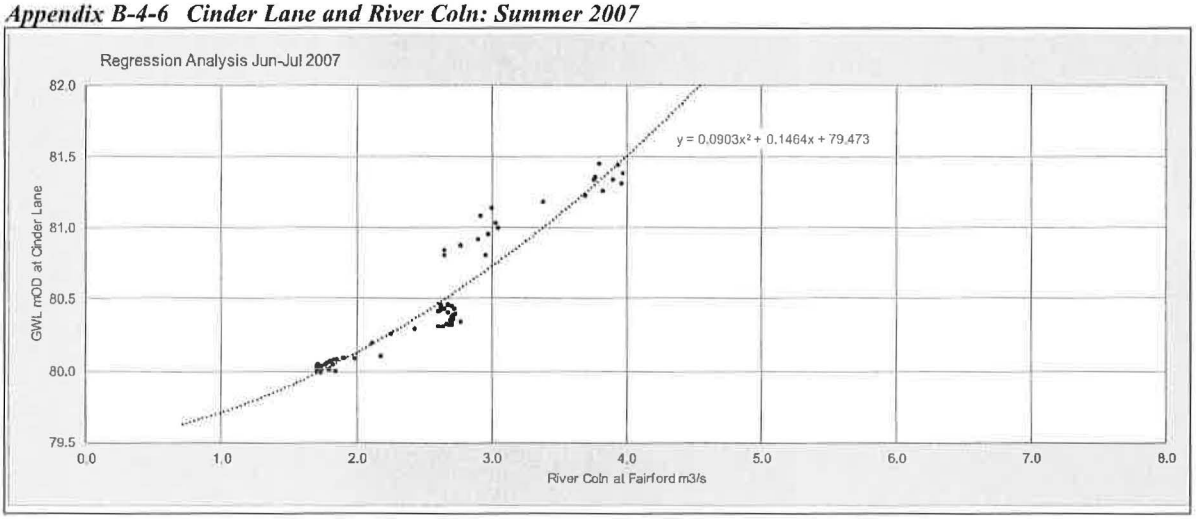
Appendix B-4-4 Donkeywell borehole 1963-1978



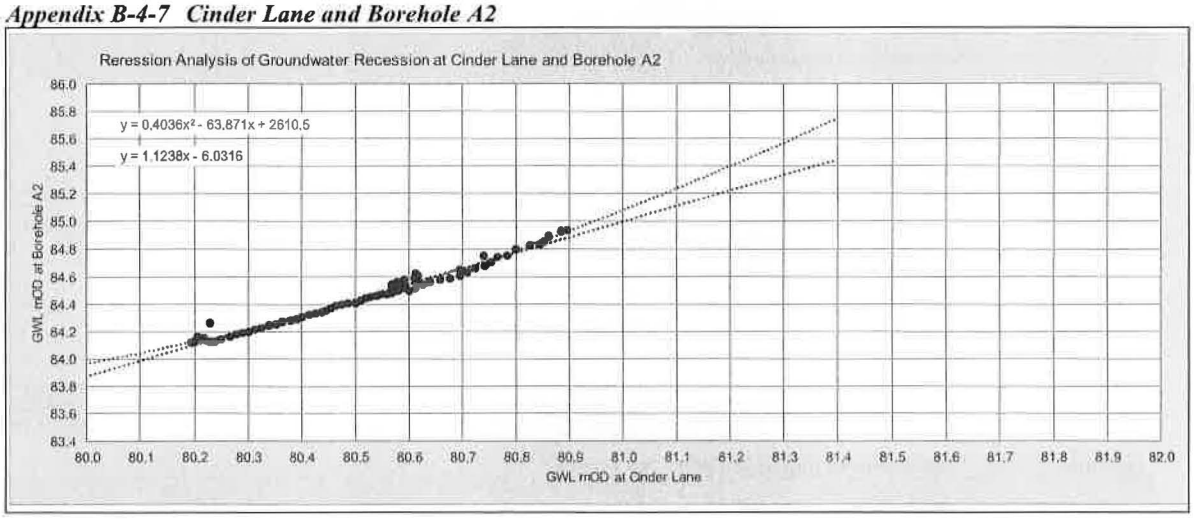
Appendix B-4-5 Cinder Lane and River Coln: full record



Appendix B-4-6 Cinder Lane and River Coln: Summer 2007

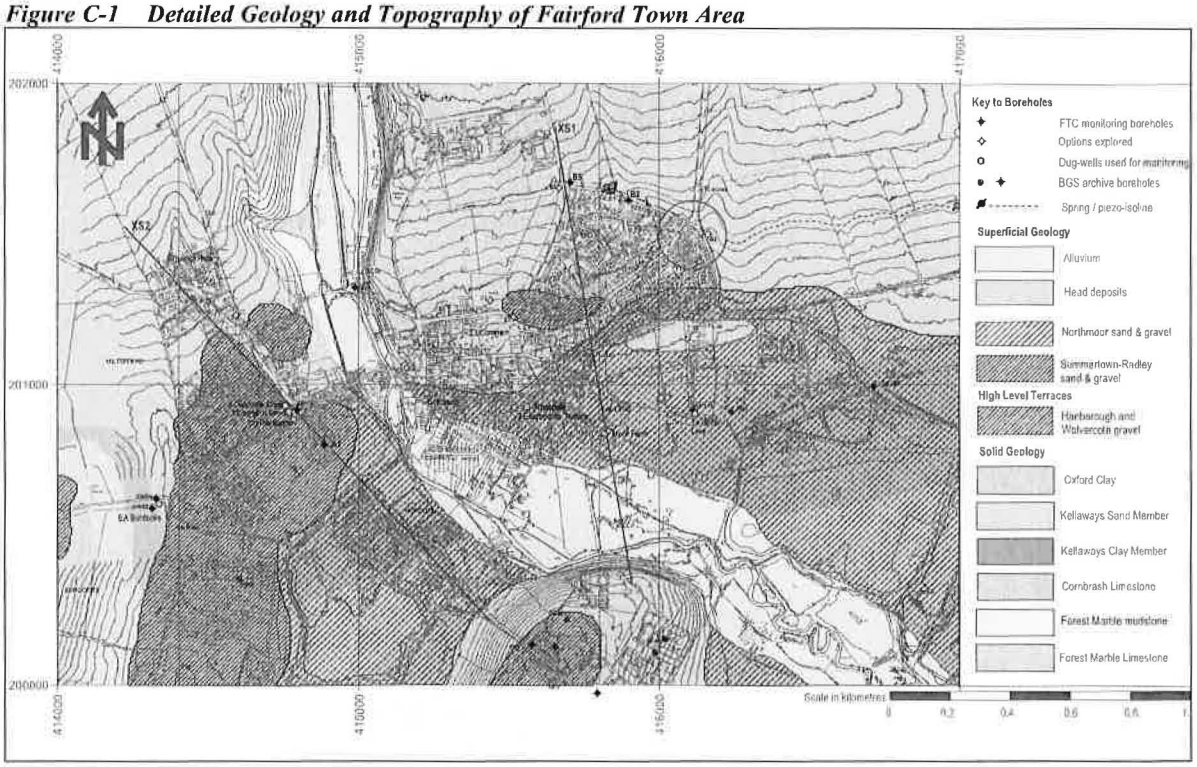


Appendix B-4-7 Cinder Lane and Borehole A2



Appendix C Detailed Maps

Figure C-1 Detailed Geology and Topography of Fairford Town Area



Superimposed on OS Mastermap extract, showing wells and boreholes

Shows location of interpreted cross-sections XS1 and XS2, drawn in Figure 3-1 and Figure C-2.

Figure C-2 Geological Cross-Section along Line XS-2 [West Side of Coln Valley]

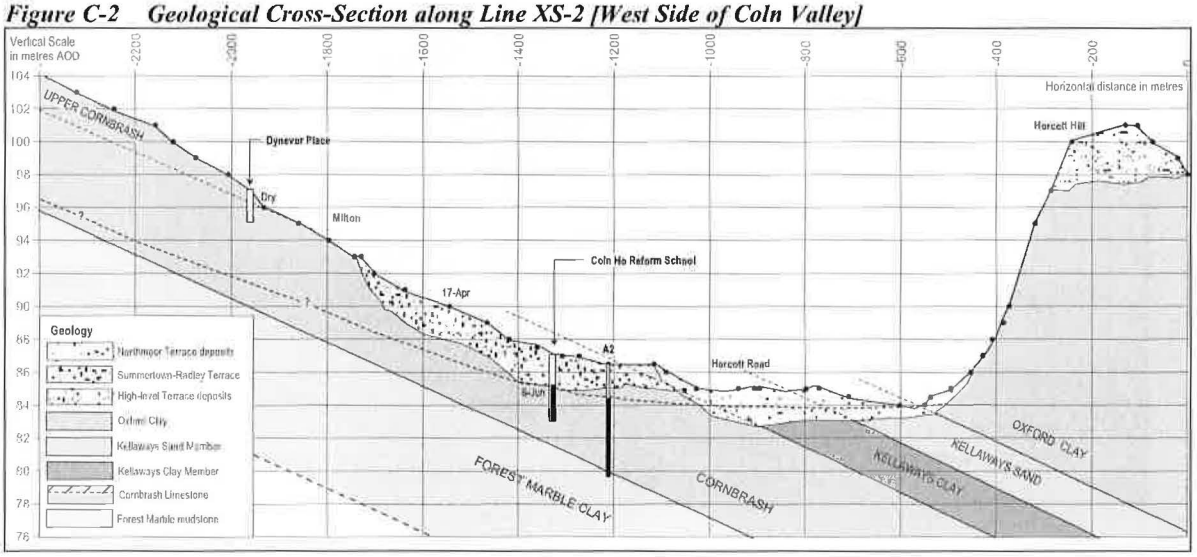


Figure C-3 Horcott Area showing Location of Borehole A2 and Head-filled Dry Valley

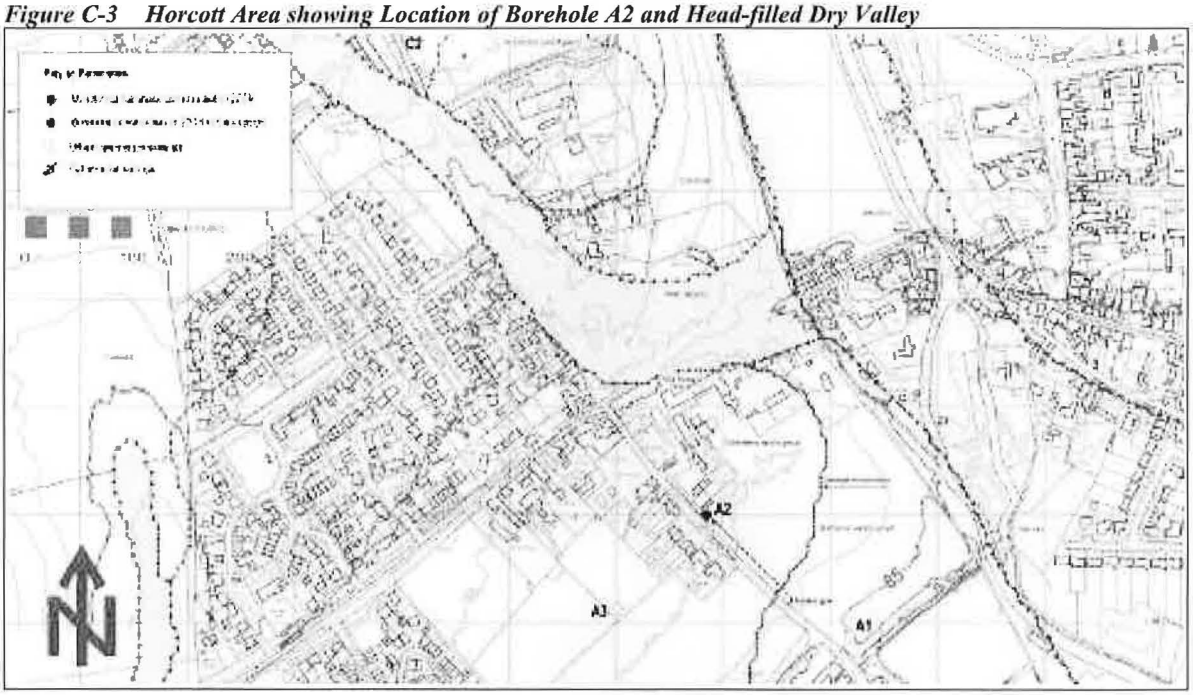


Figure C-4 Leafield Area showing Location of Boreholes B2 and B5

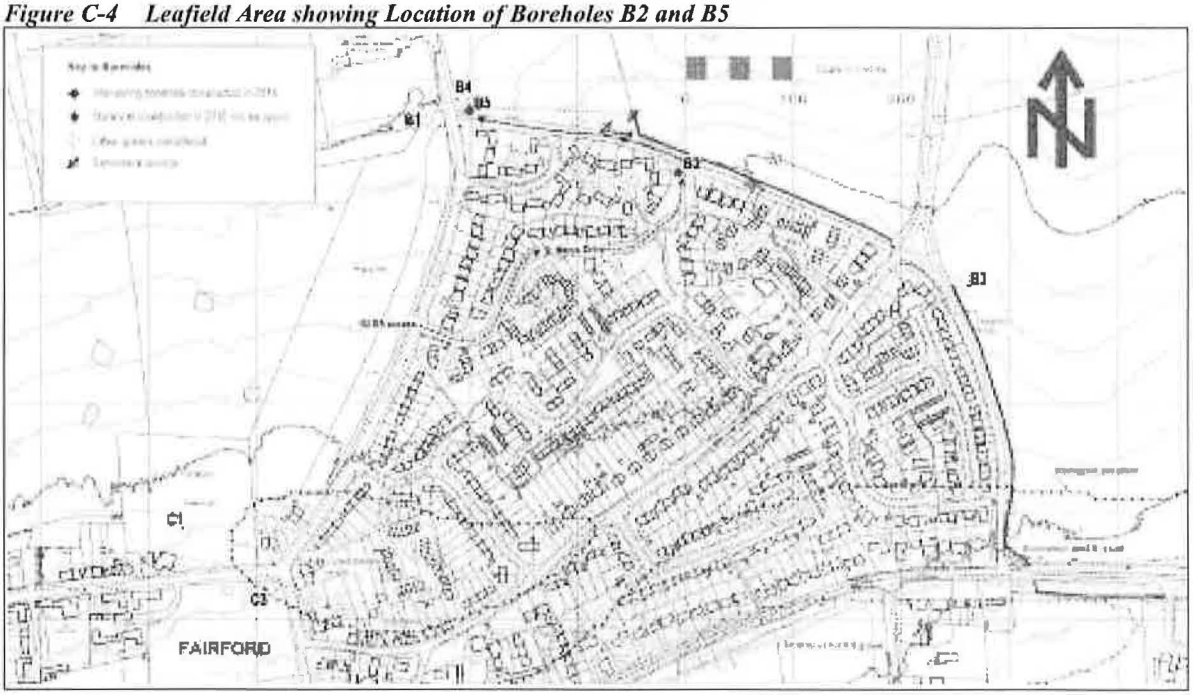
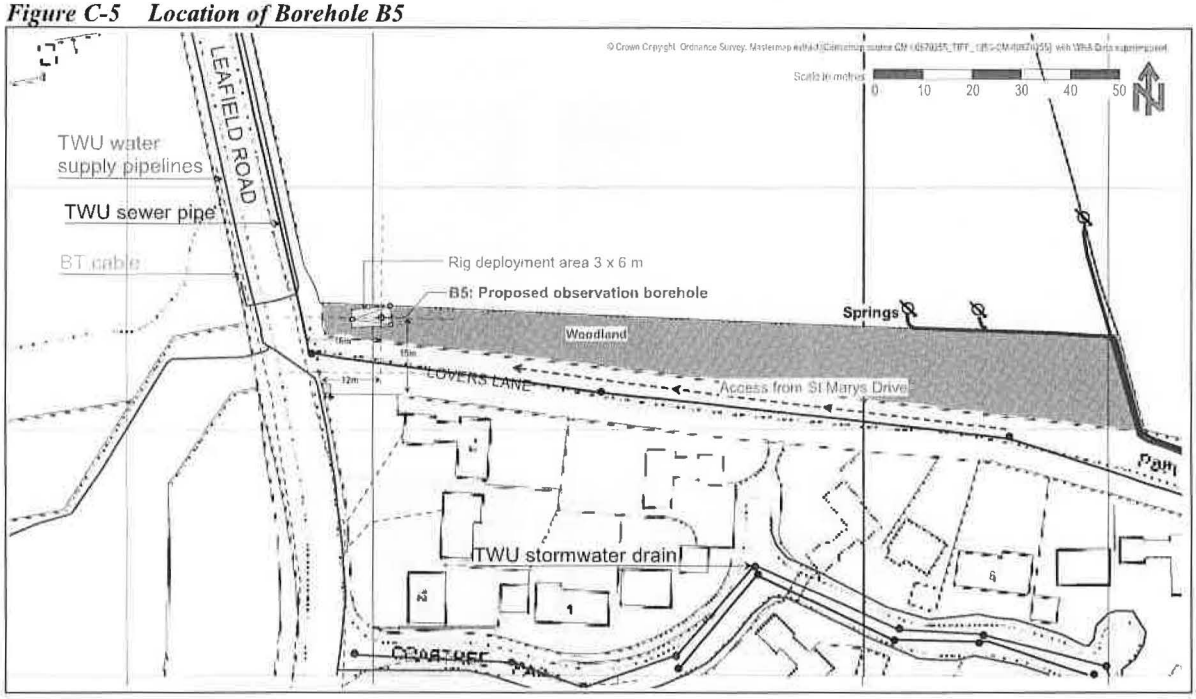


Figure C-5 Location of Borehole B5



Appendix D Reconnaissance Photo-Log

D-1 Reconnaissance Photographs and Environment Agency Boreholes

D-1 Springs on Lovers Lane

D-2 Springs at head of Thornhill Brook

D-3 Cinder Lane borehole SP10-105

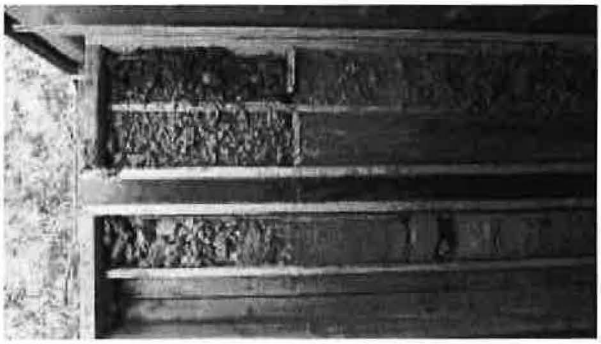
D-4 Dudgrove Brook

D-5 Burdocks borehole SP10-85

D-6 Donkeywell borehole SP12762 03418

D-2 Monitoring Boreholes

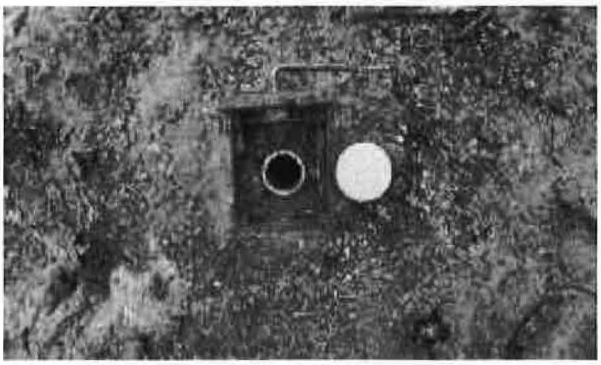
D-7 Drilling Borehole A2



D-8 Borehole A2 cuttings

D-9 Drilling Borehole B5

D-10 Borehole A2 monitoring point



D-11 Borehole B5 monitoring point

D-12 Cornbrash cuttings from Borehole B5

D-3 Well Inventory

D-13 Coln House West: well located to left of doorway

D-14 Well interior at Coln House West

D-15 Well-head at Coln House West

D-16 Well-head at 2 Dynevor Place

D-17 Dynevor Place: well on raised part of side-garden

D-18 Dug-well interior at 2 Dynevor Place

D-19 Dug-well at Comrie: well-head

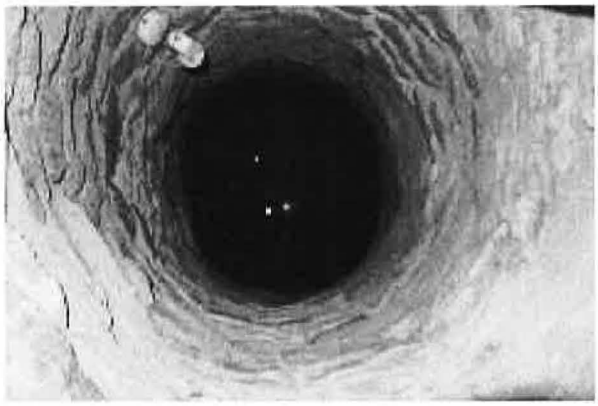
D-20 Dug-well at Manor Farm: interior backfilled

D-21 Dug-well at Manor Farm: well-head

D-22 Dug-well at Riverdale: interior

D-23 Dug-well at Riverdale: well-head

D-24 Dug-well at Colloseo: well-head



D-25 Dug-well at Colloseo: interior

Appendix E Drilling Logs

E-1 Observation Borehole Geology and Construction Details

Figure E-1 Borehole A2 Details

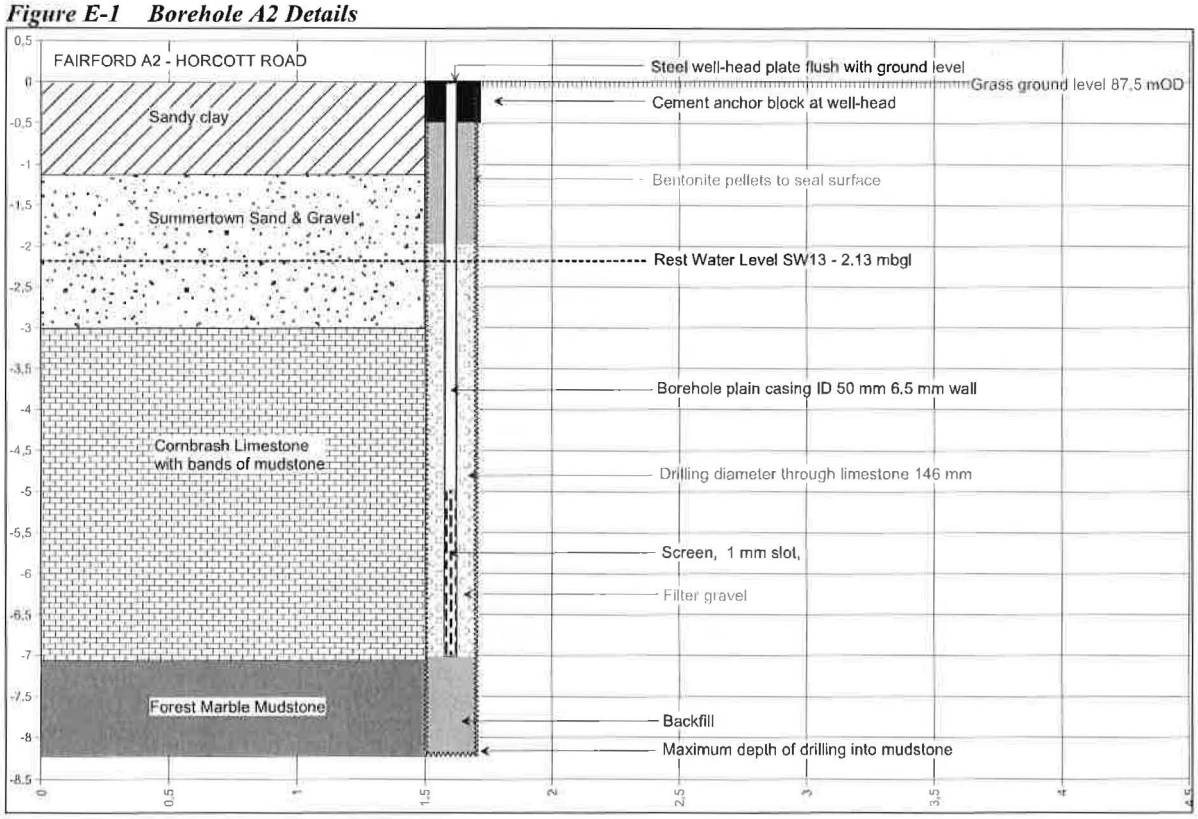
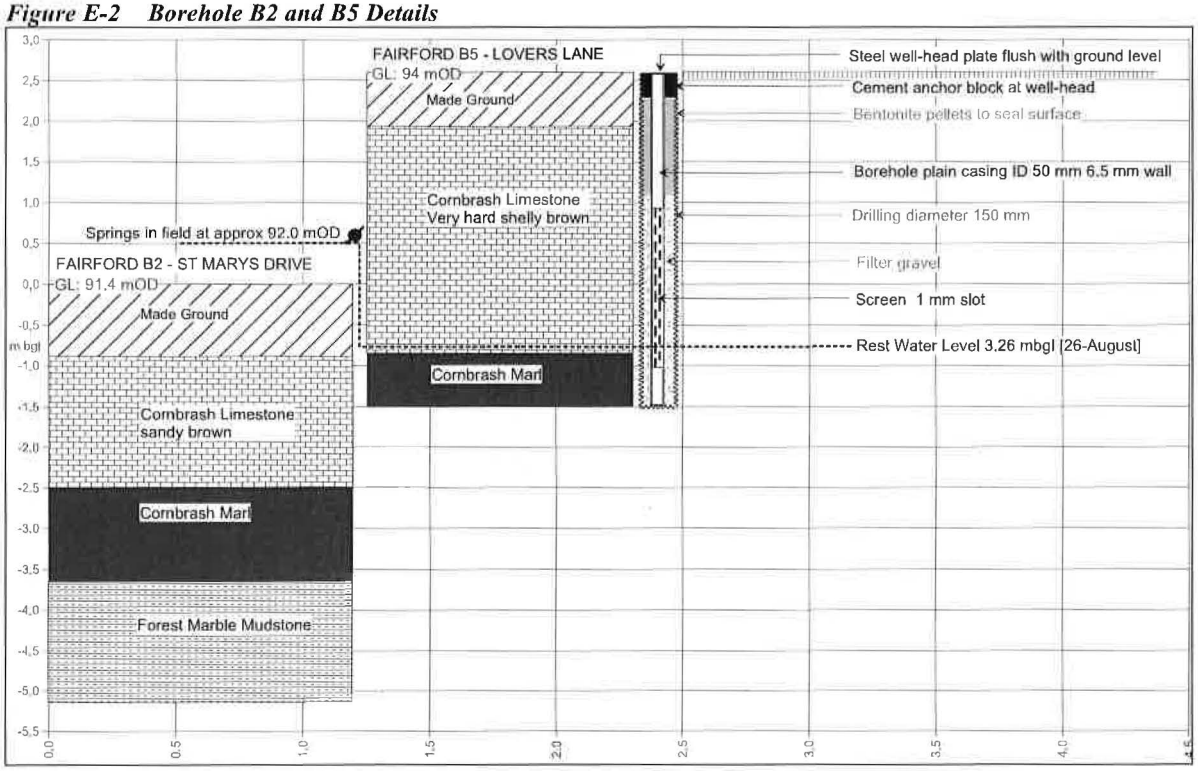


Figure E-2 Borehole B2 and B5 Details



E-2 CCGI Borehole Logs

Logging

The logging of soils and rocks has been carried out in general accordance with BS 5930 2015

Sample type

B	Large disturbed sample
C	Core run
CS	Rotary core sub-sample
D	Small disturbed sample
ES	Environmental sample
SPT	Standard penetration test carried out using split spoon (split spoon sample retained)
SPT C	Standard penetration test carried out using solid cone (no sample retained)
U75 or U100	Undisturbed sample followed by nominal diameter of sample. (Taken using thick-walled open-tube sampler – OS-1 KW)
UT100	Undisturbed sample followed by nominal diameter of sample. (Taken using thin walled open tube sampler – OS-1 JW)
W	Water sample

Water levels

Initial Water Strike	Level after monitoring	Standing Level/No groundwater encountered
▼		3.00m/Dry

Insitu Testing

S 30	Denotes SPT undertaken using split spoon followed by N Value (EN ISO 22476-3:2005+A1 2011)
C 30	Denotes SPT undertaken using solid cone followed by N Value (EN ISO 22476-3:2005+A1:2011)
'240	Denotes SPT where full test drive has not been completed and linearly extrapolated N value reported
''	Denotes no effective penetration (Linearly extrapolated N value > 1000)
H 30	Hand shear vane. Direct reading in kPa

Sample range

Undisturbed sample

Core run

U(T)100 Undisturbed Samples

Rotary core sub sample

Installation Details

Porous Tip

Screened Standpipe

Bentonite seal

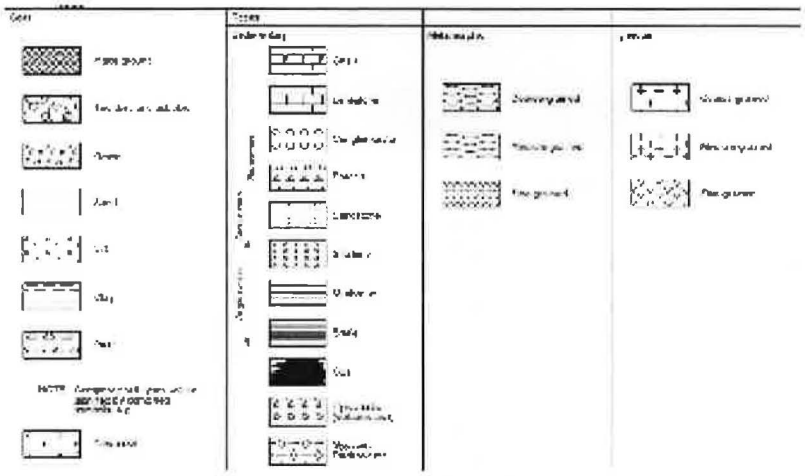
Plain standpipe

Granular response zone

Concrete

Grout

Backfill with arisings



CC Ground Investigations Ltd

ROTARY BOREHOLE LOG

Telephone: 01452 739 165, Fax: 01452 739 220, Email: info@CCGround.co.uk

Project Name: Fairford Observation Wells	Project No: C5964	Co-ords: E N	Borehole No. A2 — Sheet 1 of 2 — Hole Type DS+RC
Location: SITE A2 and B2		Level: mAOD	Scale 1:58.25
Client: Water Resource Associates LLP		Dates: Start: 01/03/2018 End: 01/03/2018	Logged By TH

Core Run Type	Depth (m)
C	1.10 - 2.50
C	2.50 - 4.00
C	4.00 - 5.50
C	5.50 - 7.00
C	7.00 - 8.20

Description	Depth (m)
Grass over firm friable dark brown slightly sandy CLAY with frequent roots and rootlets (<2mm).	0.30
Firm friable brown slightly gravelly slightly sandy calcareous CLAY with rare [illegible] (<2mm). Gravel is angular to sub-rounded fine to coarse of limestone.	0.70
Light brown sandy very clayey angular to sub-rounded fine to coarse GRAVEL of limestone.	1.10
Light brown slightly gravelly slightly silty SAND with occasional [illegible] shell fragments (<1mm). Gravel is sub-angular [illegible] of limestone.	(1.40) 2.50
Light greyish brown slightly sandy angular to sub-rounded fine to coarse GRAVEL of limestone. 2.75m: 1No. sub-rounded cobble of limestone.	2.90
Light brown gravelly very clayey SAND locally tending to slightly gravelly sandy clay. Gravel is sub-angular to sub-rounded fine to medium of limestone.	3.00 (0.65) 3.65
Weak light greyish brown and light brown LIMESTONE. Discontinuities are horizontal locally sub-vertical intersecting very closely to closely spaced stepped and undulating rough with light brown clayey sand infill (<2mm) and brown staining.	4.00
Firm light brown locally greyish brown slightly gravelly sandy CLAY. Gravel is sub-angular to sub-rounded fine to coarse of limestone.	(0.75) 4.??
Weak light greyish brown and light brown LIMESTONE. Discontinuities are horizontal locally sub-vertical intersecting very closely to closely spaced stepped and undulating rough with light brown clayey sand infill (<2mm) and brown staining. 4.25-4.50m: 1No. sub-vertical discontinuity stepped rough with slightly clayey sand infill (<2mm) and brown staining. 4.65-4.75m: 1No. thin bed of firm light brown sandy clay.	(2.40)
Medium strong locally weak grey locally light brown LIMESTONE with occasional voids (<40mm). Discontinuities are horizontal closely spaced undulating and stepped rough with light brown or grey silty clayey sand infill (<2mm). 4.70-4.95m: 1No. vertical discontinuity undulating rough with orangish brown staining. 5.05-5.20m: 1No. very thin bed of grey very clayey sand. 6.50-7.15m: With rare voids (<20mm). 6.10-6.25m: 1No. thin bed of stiff grey slightly gravelly slightly sandy clay. Gravel is sub-angular to sub-rounded of limestone. 6.25-7.15m: discontinuities are horizontal closely to medium spaced.	7.15 (1.05) 8.20
Extremely weak thinly laminated grey MUDSTONE locally tending to very stiff silty clay. Discontinuities are horizontal and sub-horizontal very closely to closely spaced undulating smooth with clay smear. 7.00-8.20m: with rare lenses (<20mm) very closely to closely spaced of light grey limestone. Borehole completed at 8.20m.	

EQUIPMENT: Hand digging tools, Fraste Multi-drill PL(G) rock coring drilling.
METHOD: Hand dug inspection pit 0.00-0.80m. Dynamic sampling using 128mm sample barrel: 0.80-1.10m. Wireline rotary coring using [illegible] coring barrel: 1.10-8.20m.
CASING: 165mm diameter to 1.00m.
GROUNDWATER: None encountered prior to using water flush during drilling process.
INSTALLATION: Borehole backfilled with bentonite pellets [illegible]. Granular filter pack: 7.00-8.15m. 50mm HDPE slotted pipe with washed gravel response zone and geo sock: 3.00-7.00m. Plain 50mm HDPE pipe with washed gravel response zone 2.00-3.00m and bentonite pellet seal: 0.2-2.00m. [illegible] cover set in concrete 0.20-0.00m. Gas valve fitted.
REMARKS: Drilling loss of flush from 2.50-7.00m.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
01/03/2018 17:00	8.20	1.00	

CC Ground Investigations Ltd

ROTARY BOREHOLE LOG

Telephone: 01452 730 166 , Fax: 01452 729 220 Email: info@CCGround.co.uk

Project Name: Fairford Observation Wells	Project No: C5964	Co-ords: E N	Hole Type DS
Location: SITE A2 and B2		Level: mAOD	Scale 1:50,25
Client: Water Resource Associates LLP		Dates: Start: 20/03/2018 End: 20/03/2018	Logged By EC

Borehole No. B2

Sheet 1 of 1

(m)	Water Level	Core Run, Samples & Testing: Type / Depth (m)	Core Run & Strength	TCR SCR FDI	Graphic	Description	Depth (m)	Level (mAOD)
1						MADE GROUND (Gravelly): Soft locally firm orangish brown slightly gravelly slightly sandy slightly clayey CLAY. Gravel is angular to sub angular fine to coarse of limestone and rare porcelain. C.00-0.03m: Occasional rootlets (<5mm). C.70m: Low cobble content. Cobbles are angular of limestone.	(0.00)	
2						Firm dark orangish brown slightly gravelly slightly sandy slightly calcareous CLAY. Gravel is angular to sub angular fine to coarse of limestone. C.00-1.63m: Sandy.	1.70	
3						Light yellowish brown and orangish brown locally slightly clayey angular to sub-rounded fine to coarse GRAVEL of limestone with low cobble content. Cobbles are sub-angular of limestone.	(0.00)	
4						Firm orangish brown locally mottled light grey slightly gravelly slightly sandy slightly calcareous CLAY. Gravel is angular to sub-angular fine to coarse of limestone.	(0.70)	
5						Firm locally stiff thinly laminated orangish brown and brown locally mottled light grey slightly gravelly slightly sandy slightly calcareous CLAY. Gravel is angular to sub-angular fine to coarse of limestone.	3.20	
6						Stiff thinly laminated grey slightly calcareous CLAY with rare lenses (<1mm) of light grey silty fine sand.	(0.00) 3.70	
7							(1.30)	
8						Very stiff thinly laminated calcareous grey silty CLAY locally trending to extremely weak mudstone with occasional closely (<1mm) spaced silty fine sand. Rotary drilling completed at 5.00m	5.00	
9							6.00	

EQUIPMENT: Hand digging tools. Commachio MC200 multi purpose tracked rig.
METHOD: Hand dug inspection pit 0.00-1.00m. Dynamic sampling using 128mm sample bag 1.00-6.00m.
CASING: None installed to 5.00m
GROUNDWATER: Groundwater encountered at 2.30m and rose to 2.10m after 20 mins, no monitoring period.
REMARKS: Hand dug inspection pit backfilled with arisings to 1.00m. Slotted pipe with washed gravel response zone and gas tap to 5.00m. Plain 50mm ID HDPE pipe with washed gravel response zone: 1.00-1.00m and bentonite plug seal: 0.10-1.00m. Push 150mm steel cover set in concrete 0.10-0.00m. Cover as built.

Groundwater:

Date	Strike Depth (m)	Casing Depth (m)	Depth After Observation (m)
20/03/18	2.30		2.10

Hole Progress:

Date	Hole Depth (m)	Casing Depth (m)	Water Depth (m)
20/03/2018 17:00	6.00	2.70	2.10

E-3 GMD Drilling Log and Samples

Groundwater Monitoring & Drilling Ltd 1 Adeane Road, Chalgrove Oxfordshire OX44 7TQ		**DRILLING LOG**	**BOREHOLE No. B5**
Equipment & Methods Pilcon Wayfarer shell and auger rig 150 mm diameter		**Location** LOVERS LANE, FAIRFORD OXFORDSHIRE GL7 4LS	
Water levels Water added to bail RWL on 26/08/18 = 3.26 mbgl Chiselling from 1.80 mbgl		**Grid Reference:** 415701, 201673 **Ground level:** 94.0 m AOD **Datum level:** Well top is 0.06 m below ground level	
Carried out for Fairford Parish Council		**Date** 25/8/18-26/08/18	
Description		**Thickness m**	**Depth m**	**Reduced Level**
Brown [7.5YR4/2] hard dry stony SOIL becoming moist dark brown [7.5YR] and slightly stony between 0.35 m and 0.50 m and brown [7.5YR5/4] at 0.6 m		0.70	0.70	
Strong brown [7.5YR5/8] clayey light grey [5Y7/1] hard rubbly limestone.		1.10	1.80	
Hard LIMESTONE light grey [[5Y7/1] with some Brownish yellow [10YR6/6] CLAY		1.60	3.40	
Firm-stiff dark grey [N4] CLAY		0.50	4.10	
Completion			**Length**	
Inspection cover set in 0.25 m concrete surround with Allen key access Bentonite pellets Pack –2- 5 mm 60 mm OD x 50 mm ID PVC plain casing 60 mm OD x 50 mm ID PVC screen with 1 mm slots 60 mm OD x 50 mm ID PVC plain casing			 1.50 4.10 1.80 3.60 4.10	
Sample No and depth [m]				
B5/1 0.00 - 0.35 m B5/2 0.35 - 0.50 B5/3 0.50 - 0.60 B5/4 0.60 - 0.70 B5/5 0.70 - 1.80	B5/6 1.80 - 2.20 m B5/7 2.20 - 2.40 B5/8 2.40 - 2.75 B5/9 2.75 - 3.40 B5/10 3.40 - 4.10			

Figure E-3 Borehole B5 Cuttings

D-1 Borehole B5 cuttings 0.50-0.60 mbgl

D-2 Borehole B5 cuttings 0.60-0.70 mbgl

D-3 Borehole B5 cuttings 0.70-1.80 mbgl

D-4 Borehole B5 cuttings 1.80-2.20 mbgl

D-5 Borehole B5 cuttings 2.75-3.40 mbgl

D-6 Borehole B5 cuttings 3.40 – 4.10 mbgl

E-4 BGS Archive Logs

SP 10 SE 4 [1625 0089], near Beaumoor Farm, Fairford Block C
Surface level [+82.0 m] +269 ft, Water struck at [+79.6 m]
Shell and auger [modified] 152 mm [6. in] diameter
June 1971
Overburden 0.6• m [2.0 ft]
Mineral 4.2 in [14.0 ft]
Bedrock 0.1 m+ [0.5 ft+]
Soil, dark brown, Thickness/ Depth 0.1, 0.1
Terrace 1 deposits Clay, silty, pebbly, dark brown. Thickness/ Depth 0.5, 0.6
Sandy gravel, with a silty calcareous matrix to 1.7 m; Thickness/ Depth 4.2, 4.8m
Gravel: fine with some coarse to 2.6 in passing into fine with coarse. Predominantly sub-rounded, platy and tabular, grey and brown oolitic limestone, with some shelly oolitic limestone.
Sand: coarse and medium with a little fine, silty in the upper part. Limestone grains and quartz, buff to 1.7 m, passing into yellowish-brown matrix to 1.7 m
Kellaways Beds Mudstone, sandy and shelly, hard, brown passing into greyish-blue, 0.1, 4.9m

SW22/SW34 GL 88.95 mAOD [SP10-85]

0 - 6.5	Cornbrash
6.5 - 14.5	Wychwood FM mudstone
14.5 - 36.5	Kemble Beds FM limestone
36.5 - 48.0	White Limestone
48 - 50	Marl
50 - 59.0	Taynton Stone
59 - 67	Stonefield Suite
67 - 79	Fullers Earth

SW13 The Retreat [near Marlborough Arms].

Groundwater found in FM at 6.4 mbgl, tested 1.14 l/s

0-1.5	Gravel
1.5-2.7	Cornbrash
2.7-13.1	FM mudstone
13.1-31.7	FM limestone

SE114 RWL 2.4 mbgl Fairford football club [SP10-105 EA]

RWL at 3.0 mbgl, drilling depth 4.6 mbgl. GL 83.31 mOD, 82.95 mOD, drilled 7-May-2002

0-0.1	top soil
0.1-0.4	brown clay
0.4-1.9	sandy gravelly clay
1.9-4.6	coarse sand and gravel [limestone boulder at 4 mbgl]

SP 10 SW 4 Burdocks

Dry, drilling depth 4.6 mbgl. GL 88.7 mOD, 82.95 mOD, drilled July-1971

0-0.2	top soil / overburden
0.2-4.1	Terrace 2 [sand and gravel]
4.1-4.5	Kellaway Beds
4.5-4.6	Cornbrash [sandy-rubbly limestone with shell debris, yellow-brown]

Appendix F NP Policy Example

This appendix provides a small extract from the Benson Neighbourhood Plan, in which WRA members are also involved, and suggests that, while the Fairford NP text is correct and fit-for-purpose, it would be made more robust by including firm policies at the end of the "Geology, Topography and Hydrology" section.

The following examples may be useful.

Extracts from Benson's fully adopted Neighbourhood Plan ['Made' in 2018]

Drainage and Flood Risk Management

14.12.1 Thames Water's Benson Drainage Strategy [2013, and updated for 2015-2020] indicates that Benson has a significant problem with the foul sewerage system being overloaded by both surface water and groundwater infiltration. The Strategy states that both urban creep [more building and loss of permeable surfaces] and climate change [which is predicted to increase the number of adverse weather events] are expected to exacerbate the problem. Thames Water quantified the rate of urban creep in Benson as 'average' in 2013 at 0.0879%, but flagged that their intention to escalate with the County Council if that figure increased. Furthermore, the Water Cycle Study for South Oxfordshire District Council [2016] confirmed that there is minimal or no Wastewater treatment works capacity at Benson.

14.12.2 Developers must work with statutory bodies to plan for the necessary wastewater management infrastructure to accommodate growth in Benson to avoid unacceptable deterioration of water quality in parish watercourses and quality of life for residents.

14.12.3 Flows in Benson Brook are influenced by the level of winter rainfall infiltrating down into the chalk aquifer and flowing out from late winter onwards, mainly entering the brook in a series of springs in Ewelme. During periods of peak flow, some residents along Brook Street reporting water rising up through their floors.

14.12.4 Developers must take account of these specific flood risks in Benson and avoid exacerbating the issue by providing adequate on-site drainage proposals. The detail of Sustainable Drainage System proposals must take account of advice from RAF Benson on the need to manage the risk of bird strike.

NP33

Development proposals should include Sustainable Drainage Systems within their boundaries designed to manage the risk of surface water flooding and foul water sewer overload, and that they will not increase flood risk elsewhere in Benson.

Sustainable Drainage Systems should be designed to maximise the benefits of the features, taking account where possible of the Benson's Strategy for Nature and People [See Appendix L].

NP34

Built development within areas which provide flood capacity for the built settlements will not be supported.

Heritage Feasibility Study

Land east of Beaumoor Place, Fairford, Gloucestershire, GL4 4AP

REF: P20-2839 **DATE:** October 2020

Introduction

1. Pegasus Group have been commissioned by Earlswood Homes Ltd to prepare this Report to consider the suitability of land east of Beaumoor Place, Fairford (hereafter referred to as 'the Site'), for allocation within the emerging Fairford Neighbourhood Plan.

2. The illustrative plan for the site proposes development of the site for 10no. residential dwellings, including 5no. retirement dwellings, and a surgery car park to be located on approximately 0.48ha of land on the east side of Fairford, as shown on the Site Location Plan provided at Plate 1.

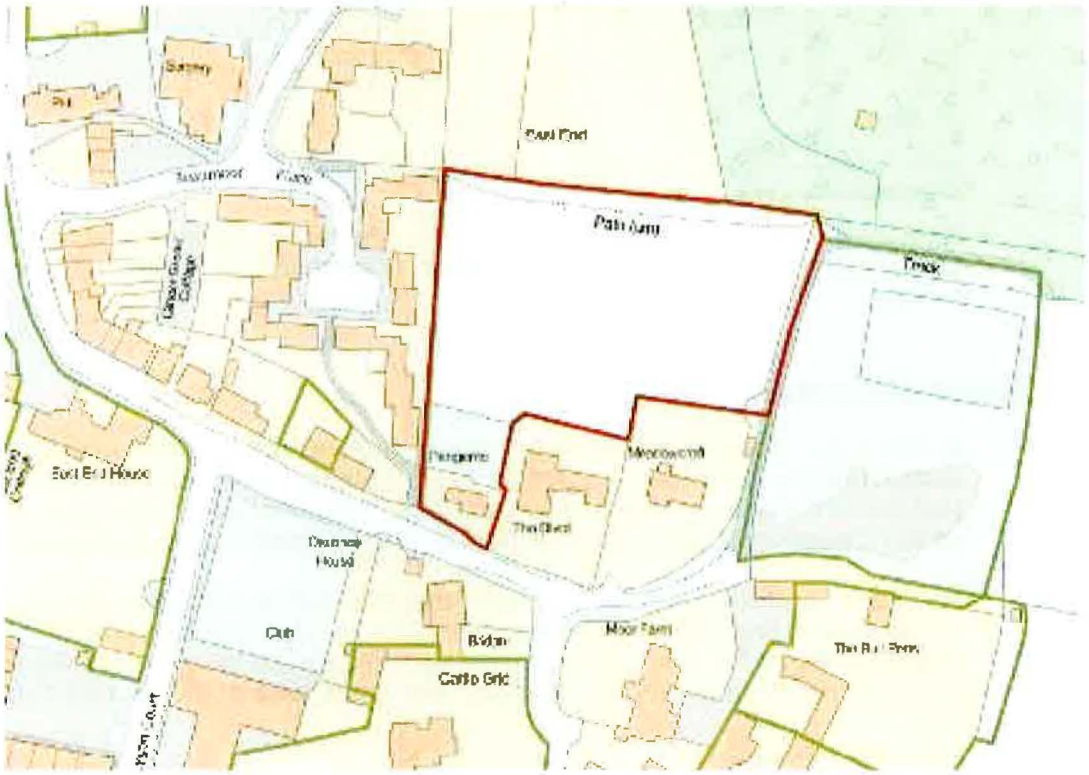


Plate 1: Site Location Plan.

3. The Site is located within the boundaries of the Fairford Conservation Area and near to the Grade II Listed Morgan Hall and Grade II Listed Moor Farmhouse.

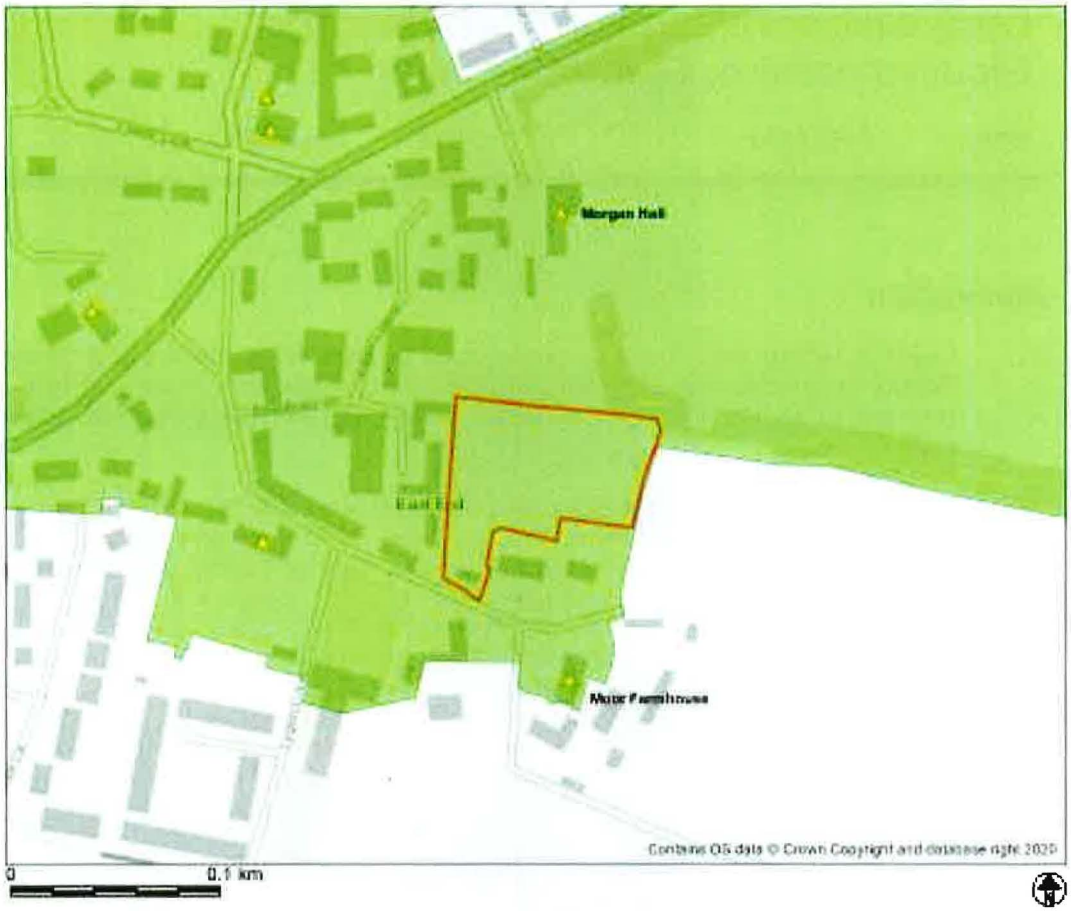


Plate 2: Map of designated heritage assets. The Site is outlined in red; the Fairford Conservation Area is shaded green; Grade II Listed buildings are marked with a yellow triangle.

Planning Background

4. In 2017, the Site was provisionally allocated for residential development within the draft Neighbourhood Plan of Fairford Town Council. Specifically, Policy FNP3 stated that the Site should be allocated for new retirement homes and a car park, comprising up to 10 dwellings and a car park with at least 20 spaces to serve the nearby surgery.[1]

5. An Examiner of the Fairford Neighbourhood Plan was appointed in March 2017, and he "*concluded that there is positive evidence for the delivery of the East End proposals (FNP3) [the Site]*".[2] The Examiner went on to recognise the potential impacts of the proposed development on the character and appearance of the Fairford Conservation

[1] Fairford Town Council, *Fairford Neighbourhood Plan 2016-2031* (pre-submission consultation draft, February 2017), p. 26.

[2] Andrew Ashcroft Planning Limited, *Fairford Neighbourhood Plan – Examiner's Report* (September 2017), p. 18.

Area and the significance of Grade II Listed Morgan Hall through setting, but concluded as follows:

> *"On the basis of the comprehensive information that has been submitted by potential developers I am satisfied that there is the potential to address these [heritage] matters in a satisfactory way. The proposed demolition of 'Pengerric' to create vehicular access has the clear potential to enhance the character or appearance of the Conservation Area. I can also see that the built development on the site has been arranged so that it reduces the potential impact of the proposal on the setting of Morgan Hall."*[3]

6. A revised draft of the Neighbourhood Plan has since been submitted for consultation by Fairford Town Council. This concludes that the Site is unsuitable for development, and therefore allocation, for two reasons: risk of groundwater flooding and heritage impacts. An accompanying Site Assessment Report prepared by AECOM on behalf of Fairford Town Council identified three designated heritage assets that have the potential to be affected by the proposals, namely the Fairford Conservation Area, Grade II Listed Morgan Hall, and Grade II Listed Moor Farmhouse. This report concluded that, *"Providing the constraints identified can be effectively mitigated, the site is considered to be potentially suitable to take forward for the purposes of the Neighbourhood Plan."*[4]

7. The following Heritage Appraisal has been commissioned to assess the significance of the heritage assets that have been identified as being potentially sensitive to the proposals; the contribution of the Site to the heritage significance of these assets, if any; and the potential heritage impacts of the proposed development on these assets, including any potential harms and/or benefits.

Proposed Development

8. As outlined above, the illustrative plan for the site shows the construction of 10no. residential dwellings, including 5no. residential retirement units, and the creation of a car park with 20 spaces.

9. The full schedule of proposed works is as follows:

- The demolition of a derelict bungalow (Pengerric) within the southernmost part of the Site to facilitate new vehicular access;
- The erection of 10no. residential dwellings;
- The laying of a car park in the north-west corner of the Site with a new footpath to serve the nearby surgery;
- Other associated hard landscaping, including laying hardstanding for driveways and parking spaces; and

[3] Ibid., pp. 22–23.

[4] AECOM, *Fairford Neighbourhood Plan: Site Assessment Report* (February 2019), pp. 32–34, quotation at p. 34.

- Associated soft landscaping, including the establishment of private garden areas, tree planting, and the creation of an area of public open space in the northern part of the Site.

10. Potential harm to the heritage significance of nearby Grade II Listed Morgan Hall which lies to the north of the site, through change to setting will be mitigated through the provision of a green buffer in the part of the Site nearest to the Listed building and a limit on the height of new built form to no more than 1½ storeys.

11. In order to preserve the character and appearance of the Fairford Conservation Area, the layout and design of the proposed dwellings will respect the local settlement pattern and architectural vernacular, with reference to the Cotswold Design Code.

12. An illustrative masterplan of the proposed development is included within the suite of documents that accompany these written representations.

Methodology

13. The following assessment has been informed by Historic England's *Historic Environment Good Practice advice in Planning Note 12: Statements of Heritage Significance: Analysing Significance in Heritage Assets*[5] (henceforth referred to as 'GPA 12: Analysing Significance'); Historic England's *Historic Environment Good Practice Advice in Planning Note 2: Managing Significance in Decision Taking in the Historic Environment*[6] (henceforth referred to as *GPA 2: Managing Significance*); and English Heritage's Conservation Principles.[7]

14. In order to relate to key policy, the following levels of harm may potentially be identified when assessing potential impacts of development on heritage assets, including harm resulting from a change in setting:

    - **Substantial harm or total loss**. It has been clarified in a High Court Judgement of 2013[8] that this would be harm that would 'have such a serious impact on the significance of the asset that its significance was either vitiated altogether or very much reduced';
    - **Less than substantial harm**. Harm of a lesser level that that defined above; and
    - **No harm** (preservation). A High Court Judgement of 2014 is relevant to this[9], in which it was held that with regard to preserving the setting of Listed building or preserving the character and appearance of a Conservation Area, preserving means doing no harm.

[5] Historic England, *Statements of Heritage Significance: Analysing Significance in Heritage Assets* (Swindon, 2019).

[6] Historic England, *Historic Environment Good Practice Advice in Planning Note 2: Managing Significance in Decision Taking in the Historic Environment* (Swindon, 2015).

[7] English Heritage, *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment* (London, 2008).

[8] EWHC 2847, R DCLG and Nuon UK Ltd v. Bedford Borough Council.

[9] EWHC 1895, R (Forge Field Society, Barraud and Rees) v. Sevenoaks DC, West Kent Housing Association and Viscount De L'Isle.

15. Preservation does not mean no change; it specifically means no harm. *GPA 2: Managing Significance* states that *"Change to heritage assets is inevitable but it is only harmful when significance is damaged"*. Thus, change is accepted in Historic England's guidance as part of the evolution of the landscape and environment, it is whether such change is neutral, harmful or beneficial to the significance of an asset that matters.

16. With specific regard to the content of this assessment, Paragraph 189 of the National Planning Policy Framework 2019 states:

> *"...The level of detail should be proportionate to an assets' importance and no more than is sufficient to understand the potential impact of the proposal on their significance..."* (our emphasis)

Planning Policy Context

17. Legislation relating to the Historic Environment is primarily set out within the Planning (Listed Buildings and Conservation Areas) Act 1990 which provides statutory protection for Listed Buildings and Conservation Areas.

18. Section 66(1) of the Planning (Listed Buildings and Conservation Areas) Act 1990 states that:

> *"In considering whether to grant planning permission [or permission in principle] for development which affects a listed building or its setting, the local planning authority or, as the case may be, the Secretary of State, shall have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses."*

19. A judgement in the Court of Appeal ('Mordue') has clarified that, with regards to the setting of Listed Buildings, where the principles of the NPPF are applied (in particular paragraph 134 of the 2012 version of the NPPF, the requirements of which are now given in paragraph 196 of the revised NPPF), this is in keeping with the requirements of the 1990 Act.

20. With regard to development within Conservation Area, Section 72(1) of the Planning (Listed Buildings and Conservation Areas) Act 1990 states:

> *"in the exercise, with respect to any buildings or other land in a conservation area, of any powers under any provisions mentioned in subsection (2), special attention shall be paid to the desirability of preserving or enhancing the character or appearance of that area"*

21. Notwithstanding the statutory presumption set out above, Section 38(6) of the Planning and Compulsory Purchase Act 2004 requires that all planning applications are determined in accordance with the Development Plan unless material considerations indicate otherwise.

The Fairford Conservation Area

22. Fairford is a historic market town and borough which developed during the medieval period at a crossing of the River Coln, some 13km (8 miles) east of Cirencester. Its late medieval economy was based on sheep-farming and wool production, with later commercial and residential expansion taking place in the post-medieval and modern eras.[10]

23. The Fairford Conservation Area was first designated on 20th January 1970 and its boundary was reviewed on 23rd May 1990. A Conservation Area Appraisal or Management Plan has yet to be published or adopted. The boundary of the Fairford Conservation Area covers an area of approximately 74ha and envelops most of the historic market town of Fairford, along with some large areas of open space within and on the outskirts of the town. At its centre is the High Street and marketplace where there is the greatest concentration of Listed buildings. The town is surrounded by water meadows and the pastoral land of the Coln Valley.

24. There are many approaches to the Fairford Conservation Area, with the A417 (Cirencester Road and London Road) forming the main approach by road from the east and west, and public footpath approaches from the south, east and west.

25. There are numerous key views within, towards and out from the Conservation Area. These include:

- Sequential views along High Street and London Road;
- Views across the grounds of Farmor's School;
- Views out from and towards the Conservation Area from Mill Lane;
- Views along Horcott Road; and
- Long-range views to the Conservation Area from the surrounding public rights of way.

Statement of significance

26. Based on a survey of the Conservation Area, and a consultation of relevant secondary literature, it is clear that the special character, appearance and interest, and hence the heritage significance, of the Conservation Area is derived from the following elements:

- The irregular layout of the town, which is shaped by the local topography, especially the River Coln, and is of historic interest in illustrating the medieval development of the settlement at an important river crossing;
- The many Listed buildings within the designation boundary which contribute to the archaeological, historic, architectural and artistic interest of the Conservation Area;
- The distinctive architectural vernacular of Fairford, characterised by coursed Cotswold stone; ashlar sill, lintel and quoin detailing; stone mullion and timber-

[10] N. M. Herbert (ed.), *A History of the County of Gloucester: Volume 7* (Oxford, 1981), p. 69–70.