NYMNPA

20/12/2018

Drainage Philosophy

18T1486 – Rural Conversion at Faceby Lodge Farm

Billinghurst George & Partners
Civil & Structural Engineers, Building Surveyors
Wellington House, Wellington Court, Preston Farm, Stockton-on-Tees, TS18 3TA
@BGPconsulting

Drainage Philosophy

Project: Rural Conversion at Faceby Lodge Farm

Client: Jomast

LLFA: North Yorkshire County Council

BGP Job No: 18T1486

Document Checking:

Prepared By: S Ramshaw – Associate Director

Signed:

Checked By: J Conway – Director

Signed:

Issue	Status	Date	Checked
001	Planning	Nov 2018	JC

Contents

Appendices

1. Executive Summary / Project Background

1.1. MD² Consulting have appointed Billinghurst George & Partners (BGP) on behalf of Jomast to prepare a Drainage Strategy for the conversion of outbuildings at Faceby Lodge Farm, North Yorkshire, see Appendix A.

1.2. This Drainage Philosophy has been prepared to supplement the Proposed planning application.

1.3. The planning application is for the conversion of existing farm buildings into 11 residential units.

1.4. A hierarchy for the appropriate disposal of surface water is included within Building Regulations Part H3 which states the following:

> *"Rainwater from a system provided … shall discharge to one of the following, listed in order of priority:*
>
> *1) An adequate soakaway or some other adequate infiltration system; or, where this is not reasonably practicable,*
> *2) A watercourse; or, where that is not reasonably practicable,*
> *3) A sewer."*

1.5. The following Drainage Philosophy addresses each element of the above hierarchy and details how the surface water and foul water will be discharged and attenuated for the site.

1.6. BGP have prepared this report based on current information available. This report is subject to change should the information change or new information be presented.

2. Existing Site & Drainage

2.1. SITE LOCATION

2.1.1 Site Name: Faceby Lodge Farm

2.1.2 Site Address: Faceby Lodge Farm, Carlton-In-Cleveland, Middlesbrough TS9 7DP

2.1.3 OS Grid Reference: 449677, 504053

2.1.4 National Grid Reference: NZ496040

2.2. SITE DESCRIPTION

2.2.1 Gross Site Area: 0.99ha

2.2.2 Existing Land Use: former agricultural buildings, sheds and yards

2.2.3 Proposed Land Use: Residential Development.

2.2.4 Local Planning Authority: North Yorkshire

2.2.5 Sewer Undertaker: Northumbrian Water LTD (NWL)

2.2.6 The site is to the East of Faceby Manor and to the south of A172. Faceby beck lies approximately 190m south of the site

2.3. SITE LEVELS

2.3.1 A topographical survey was carried out in April and can be viewed in appendix B.

2.3.2 The site sits at a higher level in relation the surrounding. The site is approximately 20m higher than the A172 to the North. The site also sits higher than Faceby Beck to the South by roughly 7m.

2.4. EXISTING WATERCOURSES

2.4.1 There are no known watercourses on or adjacent to the site boundaries.

2.3.1 The closest Watercourse known as "Faceby Beck" Lies approximately 190m South of the site at an elevation of 93m A.O.D. (taken from Lidar data)

2.3.2 The flood maps have been examined and the site is not affected by this watercourse.

2.5. EXISTING PUBLIC AND PRIVATE DRAINAGE

2.5.1 See appendix C for locations of existing NWL public drains

2.5.2 The majority of the private drainage network from the existing site seems to flow North towards the A172.

2.5.3 There are a number of soakaways picked up on the topographic towards the South of the site. The suitability of these are unknown.

2.6. EXISTING GROUND CONDITIONS

2.6.1 No Site investigation has currently been carried out.

2.6.2 A review of the "British Geological Society" Website has been reviewed for nearby boreholes. A Borehole located approximately 30m North along the access lane is present. This identifies firm clay to a depth of 18m.

2.6.3 No groundwater was encountered within the nearby borehole.

2.6.4 Based on the above, the likelihood of any infiltration occurring is minimal.

2.7. FLOOD RISK ASSESSMENT

2.7.1 The EA flood Maps have been reviewed and the site lies within a flood zone 1. Zone 1 is suitable for More Vulnerable developments and therefore the proposed housing is acceptable within this. As the site is elevated significantly higher than the surrounding land, risk of flooding is very Low.

2.7.2 The EA surface water flood maps have also been examined and confirm no local surface water flooding of the site.

2.7.3 Based on the above, the site is not at risk from flooding.

2.7.4 See appendix H for flood maps.

2 Proposed Site Details

3.1 DEVELOPMENT PROPOSALS

3.1.1 The proposals are to convert existing buildings to create 11 dwellings.

3.1.2 Access to the site will be gained via the existing road to the North which leads to the A172.

3.1.3 The proposed site plan developed by SP&A Architects can be found within appendix D.

3 Proposed Surface Water Drainage

4.1 Existing Drainage Regime

4.1.1 The existing site is classified as Brownfield and existing drainage networks exist around the buildings and hardstanding areas. Gullies and rain water pipes are visible through the development.

4.1.2 The existing hardstanding drained area equates to approximately 6000m2

4.1.3 The exact outfall for this drainage is currently unknown.

4.1.4 Based on a conservative discharge rate of 50mm/hr, the existing site discharges approximately **83.4l/s.**

4.2 Current Guidelines

4.2.1 In accordance with Building Regulations and NPPF the disposal of surface water has been considered in the following order of priority; discharge to ground, where not reasonably practicable, a watercourse, or where not reasonably practicable a sewer.

4.2.2 NYCC Suds Design Guidance has been reviewed. Within chapter 4.3 it states "For a whole or part brownfield site; greenfield runoff rate and/or 70% of demonstrable existing positively drained runoff rate for those rainfall events will be permitted however greenfield runoff rate should be achieved where possible."

4.3 Discharge to Ground

4.3.1 Discharge of the surface water to ground via infiltration is suited to sites which have ground conditions made up of gravel, sand or a mixture of the two. Sands and gravels permit rapid dispersion and infiltration of surface water which is necessary to ensure that overland flooding does not occur during intense rainfall periods.

4.3.2 No Site investigation is currently available but a review of the British geological society borehole maps identifies a borehole just North of the site which indicates firm clay.

4.3.3 Due to the presence of firm clay, it is unlikely that any water will soakaway. Plus, the presence of drainage on site indicates that infiltration to the ground is not achievable.

4.4 Discharge to a Watercourse

4.4.1 The nearest existing watercourse is Faceby Beck located approximately 190m south. And sits approximately 6m lower in elevation than the site level.

4.4.2 Based on the above, it is deemed viable to discharge surface water from the site to this watercourse.

4.4.3 It is also understood that a proportion of the site already flows toward the watercourse.

4.4.4 Dialogue with the Lead Local flood authority will need to take place to determine flow rates.

4.5 Discharge to Sewer

4.5.1 As discharge to a watercourse is viable, discharge to a sewer is not considered.

4.5.2 The nearest sewer is located in the village of Faceby some 800m to the South.

5.0 Surface Water Proposals

5.1.1 The total impermeable area of the proposed site equates to 0.496ha, see appendix G for site layout.

5.1.2 It is proposed to upgrade the existing surface water drainage from the scheme and route it towards the watercourse to the south.

5.1.3 The discharge rate is to be set at 5 l/sec as it is generally accepted that it is not practical to control the discharge rate to below 5 l/sec due to blockages and maintenance issues of the sewer network. This is also an improvement on the existing regime.

5.1.4 Flows above this restricted discharge rate are to be attenuated on site for up to and including the 1 in 100yr +40% storm event.

5.1.5 A 40% increase in rainfall due to climate change has been considered inline with the LLFA Suds design Guidance document, to determine exceedance flow routes and attenuation capacity.

5.2.1 Exceedance flows above the restricted rate are to be attenuated on site via either a crate or tank system.

5.2.2 It is proposed to create the attenuation requirement from oversized pipes or tanks located around the development.

5.1.6 It is proposed to discharge surface water into the Faceby Beck to the south of the scheme at a restricted rate of 5l/s.

5.1.7 All proposed sewer infrastructure including the attenuation systems will be managed and maintained privately by a management company.

5.1.8 Please see appendix G for a copy for the proposed drainage Layout.

5.2. Attenuation Requirements

5.2.3 The estimated storage volumes required to achieve the restricted surface water runoff of 5.0 l/sec are indicated below. The storage volume are approximate only and may be revised during detailed design.

Storage Estimates		
Return Period	**Micro Drainage Output (m^3)**	**Estimated Storage Volume (m^3)**
1 year	31m^3 to 60m^3	46m^3
30 year	112m^3 to 179m^3	146m^3
100 year + 40% CC	258m^3 to 387m^3	323m^3

5.2.4 A total approximate storage area of 323 m^3 of attenuation is required based on the 1 in 100 year + 40% climate change event.

5.2.5 See Appendix F for the Windes Source Control attenuation calculations.

5.3. Water Quality

5.3.1. Water quality will be assessed and mitigated following the index approach outlined within the Suds Manual C753 and in accordance with the LLFA. Discussions with the LLFA where carried out due to site constraints and nature of the development and the following approach has been agreed:

- Pervious paving should be utilised in the parking bay areas to provide a level of rainwater treatment.
- A Silt Trap will be installed before the inlet and outlet to the attenuation system to prevent sediment build up and provide a further level of treatment.
- Production of a SuDs management plan will be provided to maintain the water treatment throughout the development life of the project.

5.4. Flow Paths

5.4.1. Assessments of overland flow paths as a result of surcharging during extreme storm events will be undertaken during the detailed drainage design. This will ensure exceedance flooding does not pose a risk to existing or proposed dwellings.

5.4.2. It is anticipated that any exceedance flows will fall towards the surrounding agricultural fields owned by the developer and therefore no issue.

6. Proposed Foul Water Drainage

6.2. Due to the lack of adoptable drainage systems in the area, a sewerage treatment plant will be required. The overflow soakaway will be a shallow herringbone system in the surrounding field.

6.3. Drainage will fall via gravity to the sewerage treatment plant and be kept separate from the surface water drainage.

6.4. A discharge agreement with the EA will be required for "Discharge to ground"

7. Conclusion

7.1. From the above assessment, we conclude that the proposed development can cater for the disposal of both foul and surface water.

7.2. Surface water discharge will be restricted in accordance with the LLFA comments.

7.3. Storage is to attenuate on site via create or tank system up to and including the 1 in 100yr +40% climate change event and is to be privately maintained and managed.

7.4. A SuDs management plan should be prepared due to the private ownership of the SuDs system to ensure it continues to operate as designed.

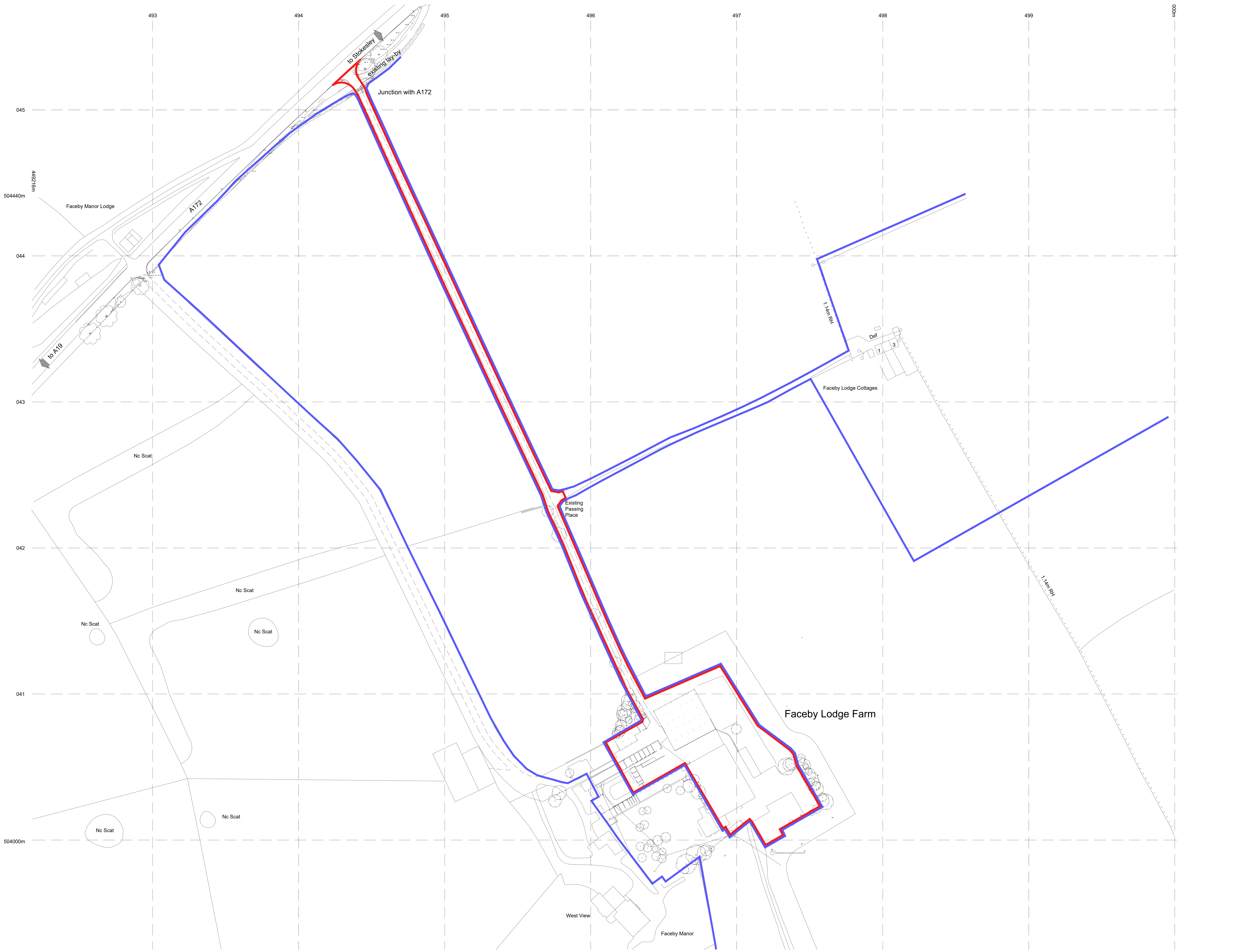
7.5. A proposed drainage strategy is shown in appendix G.

7.6. This statement has been prepared with reference to the information available at the time of writing. The details of the report may be revised upon receipt of additional or further information.

Appendix A

Site Location Plan

Preliminary



Rev A - Red line adjusted to include storage barn opposite stables HH.24.08.18
Rev B - Red line adjusted to exclude storage barn opposite stables HH.05.10.18
REVISIONS :

SPA ARCHITECTS
incorporating DKS Architects
1 Burdon Way, Stokesley Business Park, Stokesley, Middlesbrough. TS9 5PY
T: 01642 591555 E: mail@spa-architects.com

Client :
S J & J MONK

Project :
Faceby Lodge Farm

Drawing :
Location Plan

Status :		Date :
Preliminary		28 June 2018
Drawn by : Nrt	Checked by : Md	Scale : 1/1250 @A1

Project No :	Originator :	Volume / System :	Level / location :	Type :	Role :	Dwg No :
18030	SPA	00	00	DR	A	P100
Suitability : S0	Suitability Description :					Rev : B

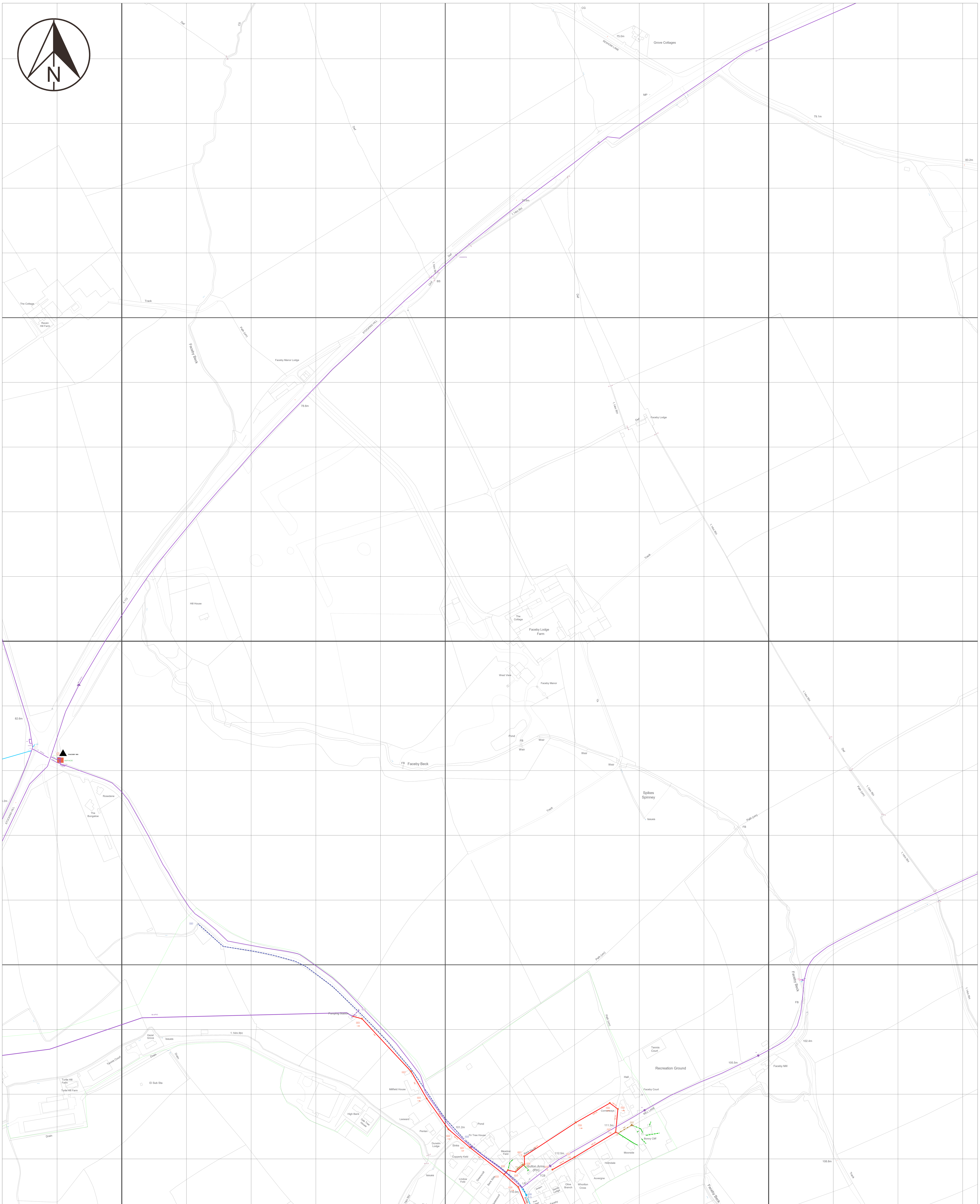
Appendix B

Topographical survey

LF0	449666.404	504718.759	78.124
LF1	449574.348	504661.006	79.871
LF2	449490.411	504576.967	80.083
LF3	449447.658	504521.627	79.870
LF4	449392.952	504487.573	80.056
LF5	449288.171	504384.876	78.884
LFA	449618.100	504668.209	79.408

Appendix C

NWL Correspondence



Waste Water - NWL Responsibility

- Combined
- Foul
- Surface
- Treated Eff
- Untreated Eff
- Overflow

Private/Non NWL

- Combined
- Foul
- Surface
- Treated Eff
- Trade Eff
- Watercourse

Proposed

- Combined
- Foul
- Surface

Water Network - Network Types

- Distribution
- Treated
- Raw
- Fire
- Supply
- Private

- AB Asbestos
- Abandoned
- Out of Comm

User : CAPEL

Date : 20/11/2018 15:18:54

Map Sheet : NZ4904SE

Title :

Centre Point : 449569,504057

Paper / Scale : A0@1:2000

NORTHUMBRIAN WATER *living water*

The information shown on this plan should be regarded as approximate and is intended for guidance only. No Liability of any kind whatsoever is accepted by Northumbrian Water, it's servants or agents for any omission. The actual position of any water mains or sewers shown on the plan must be established by taking trial holes in all cases. In the case of water mains Northumbrian Water must be given two working days notice of their intention to excavate trial holes. With effect from 1 October 2011, private lateral drains and sewers automatically transferred to Northumbrian Water under a scheme made by the Secretary of State pursuant to section 105A Water Industry Act 1991. These former private drains and sewers together with existing private connections may not be shown but their presence should be anticipated. WARNING...Where indicated on the plan there could be abandoned asbestos cement materials or shards of pipe. If excavating in the vicinity of these abandoned asbestos cement materials, the appropriate Health & Safety precautions should be taken. Northumbrian Water accepts no liability in respect of claims, costs, losses or other liabilities which arise as the result of the presence of the pipes or any failure to take adequate precautions.
Emergency Telephone Number: 0345 717 1100

20 m

Appendix D

Site Layout

REVISIONS:

Revision A. Drawing updated following NYMNP comments. 05.10.15
Revision B. Layout updated. HH 18.09.18
Revision C. Layout updated. HH 09.10.18

DO NOT SCALE, THE CONTRACTOR IS RESPONSIBLE FOR CHECKING DIMENSIONS UNLESS OTHERWISE STATED

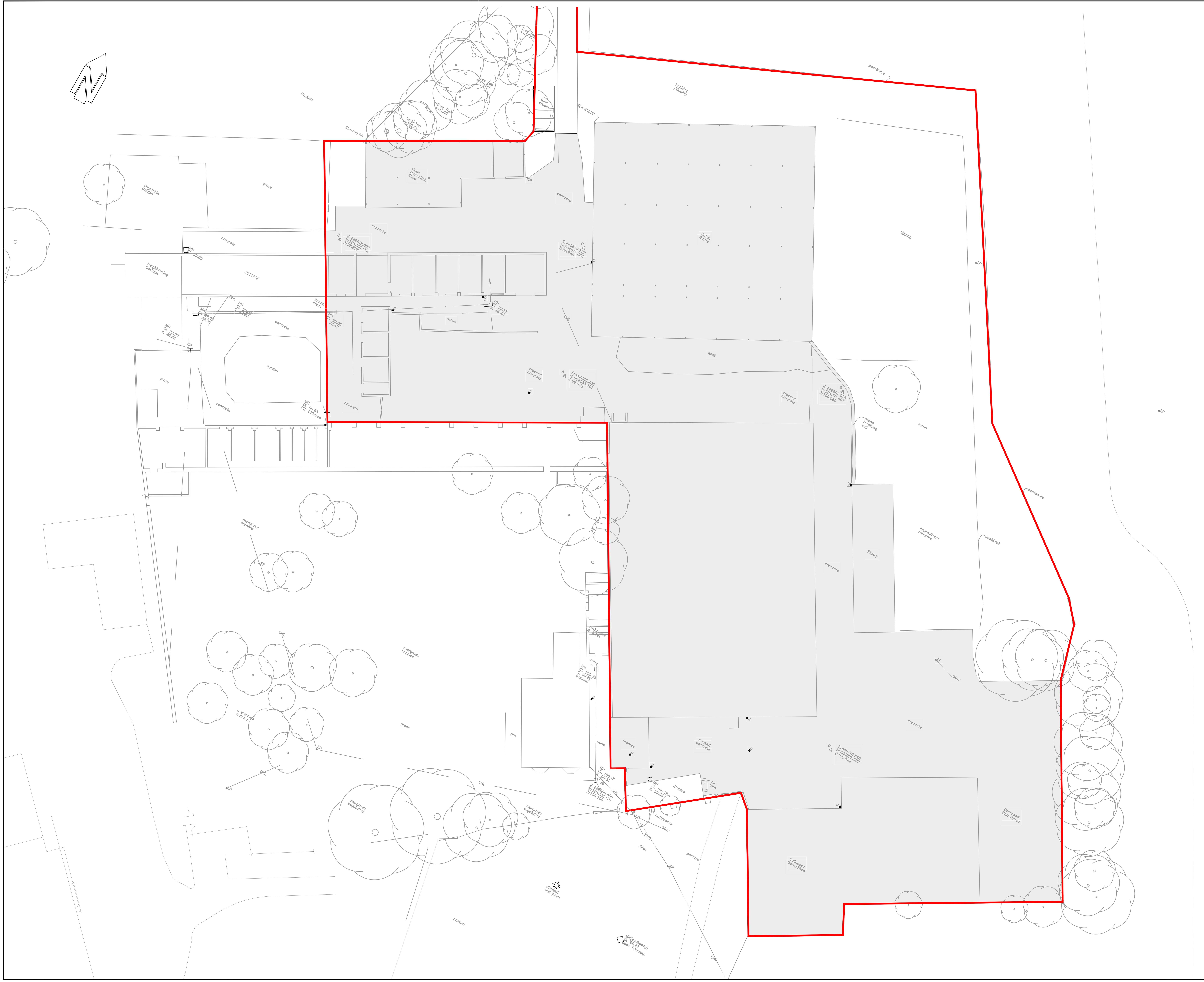
Client	S J & J MONK
Project	Faceby Lodge Farm
Drawing	Proposed Site Plan
Scale	1:200 at A1
Date	04.10.13
Drawn by	JC
Project No	12.061
Dwg No	P104
Rev	C

The Design Studio Ellerbeck Court Stokesley Business Park Stokesley Middlesbrough TS9 5PT

DKS ARCHITECTS

Appendix E

Pervious Paving



DO NOT SCALE

Key

- Existing Impermeable Area = 6073m² (0.607ha)

- Site Boundary Line

Issued for Information	ZW	P1	SR	20.11.2018
AMENDMENT	BY	REV	CHK	DATE

Rev P = Preliminary T = Tender C = Construction LCI = Last Construction Issue

In instances where this drawing completes or partly completes a contract, Billinghurst George & Partners will consider that it's product has been validated, unless in a period not exceeding 90 working days, the client advises to the contrary.

Client
Jomast

Project
Faceby Lodge Farm
conversion of existing buildings

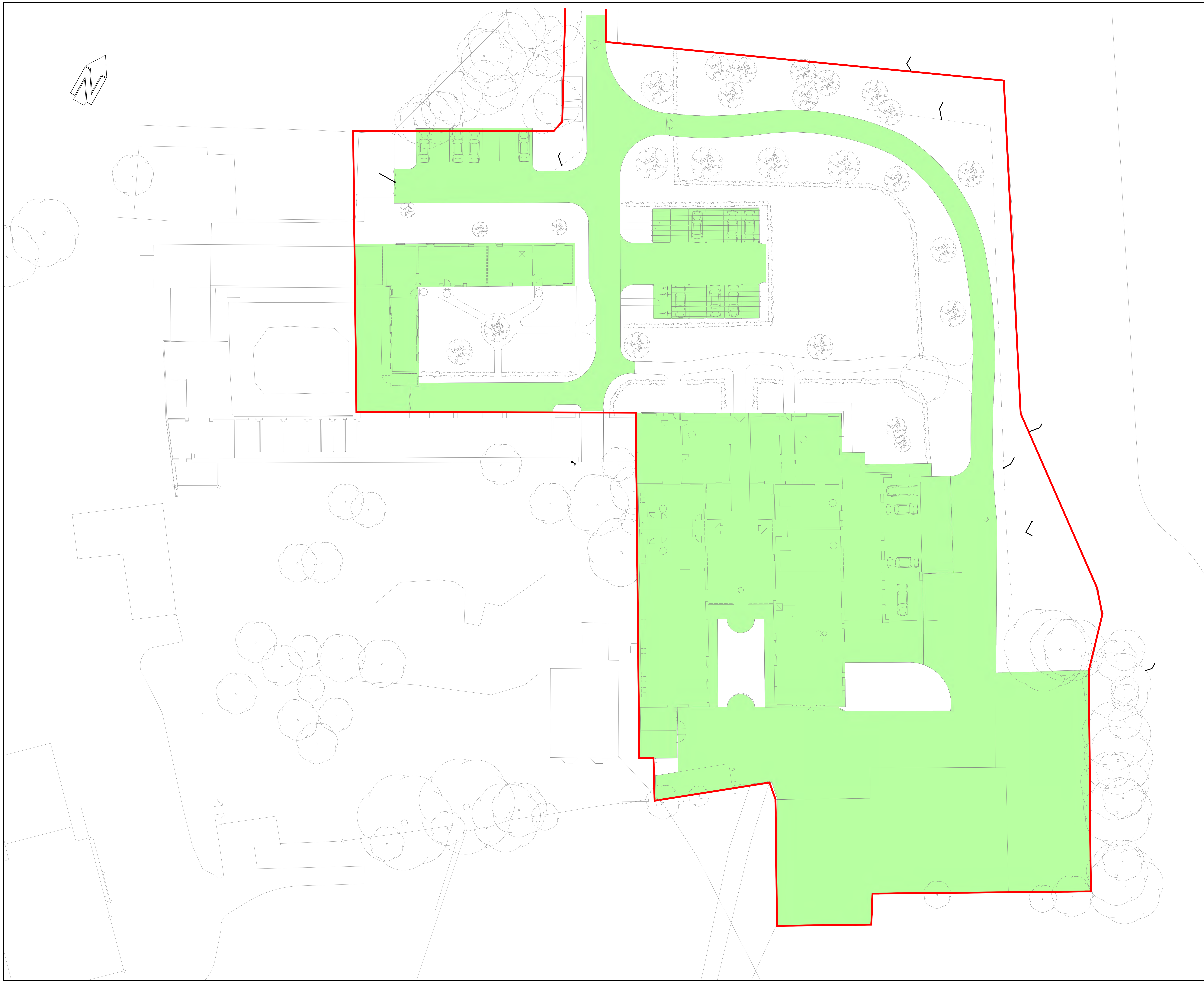
Drawing Title
Existing Impermeable Areas Plan

Drawn	Z.Waller	Date	14.11.2018
Checked	S.Ramshaw	Date	14.11.2018
Scale	1:250	Original Size	A1

Billinghurst George & Partners
CIVIL & STRUCTURAL ENGINEERS
BUILDING SURVEYORS

1st Floor, Wellington House, Wellington Court,
Stockton-on-Tees, TS18 3TA

Drg. No. 18T1486-900 Rev. P1



DO NOT SCALE

Key

- Proposed Impermeable Area = 4960m^2 (0.496ha)
- Site Boundary Line

AMENDMENT	BY	REV	CHK	DATE
Issued for Information	ZW	P1	SR	20.11.2018

Rev P = Preliminary T = Tender C = Construction LCI = Last Construction Issue

In instances where this drawing completes or partly completes a contract, Billinghurst George & Partners will consider that it's product has been validated, unless in a period not exceeding 90 working days, the client advises to the contrary.

Client
Jomast

Project
Faceby Lodge Farm
conversion of existing buildings

Drawing Title
Proposed Impermeable Areas Plan

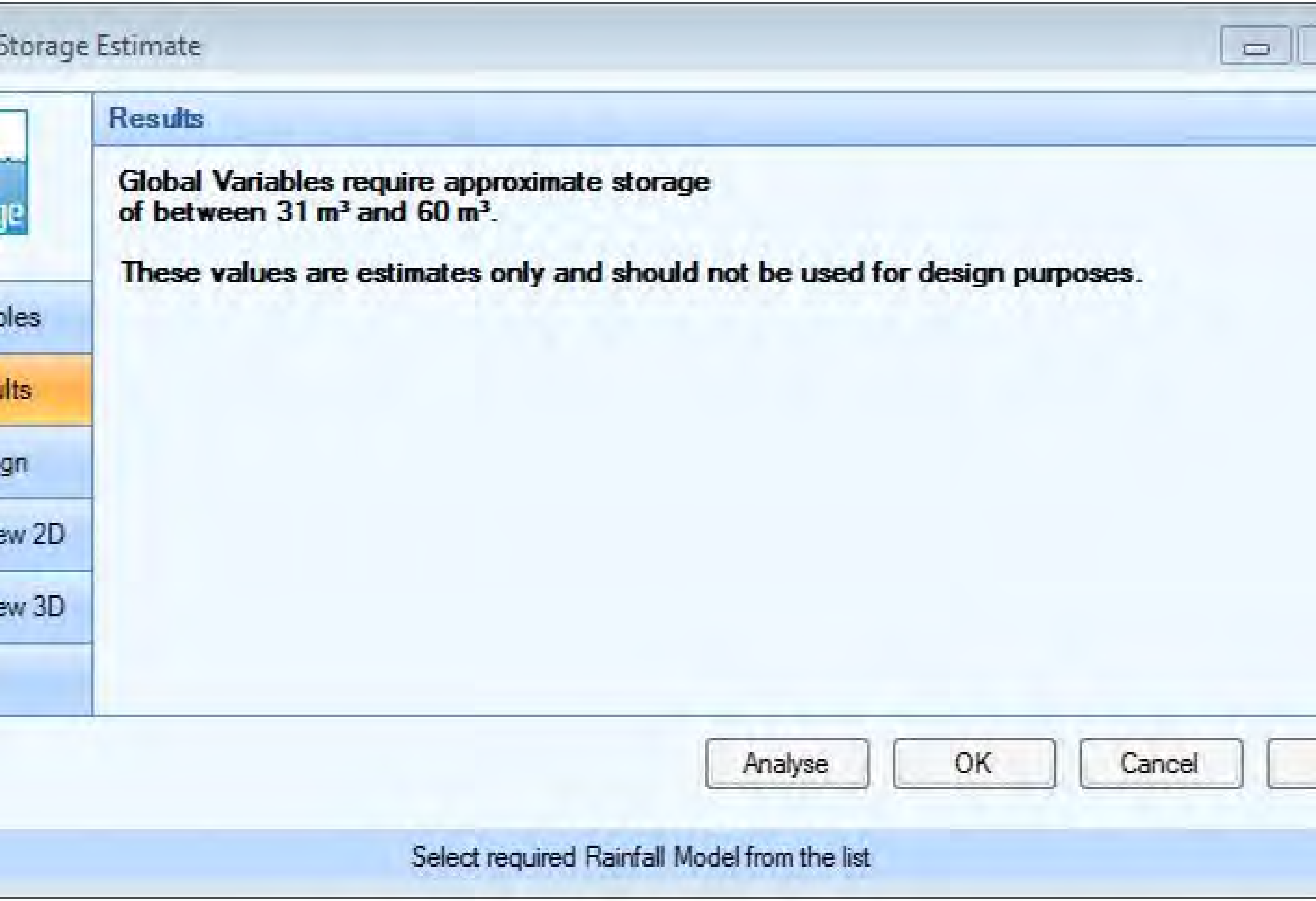
Drawn	Z.Waller	Date	14.11.2018
Checked	S.Ramshaw	Date	14.11.2018
Scale	1:250	Original Size	A1

Billinghurst George & Partners
CIVIL & STRUCTURAL ENGINEERS
BUILDING SURVEYORS
1st Floor, Wellington House, Wellington Court,
Stockton-on-Tees, TS18 3TA

Drg. No. 18T1486-901 Rev. P1

Appendix F

Windes Calculations



Storage Estimate
Results
Global Variables require approximate storage
of between 31 m³ and 60 m³.
These values are estimates only and should not be used for design purposes.
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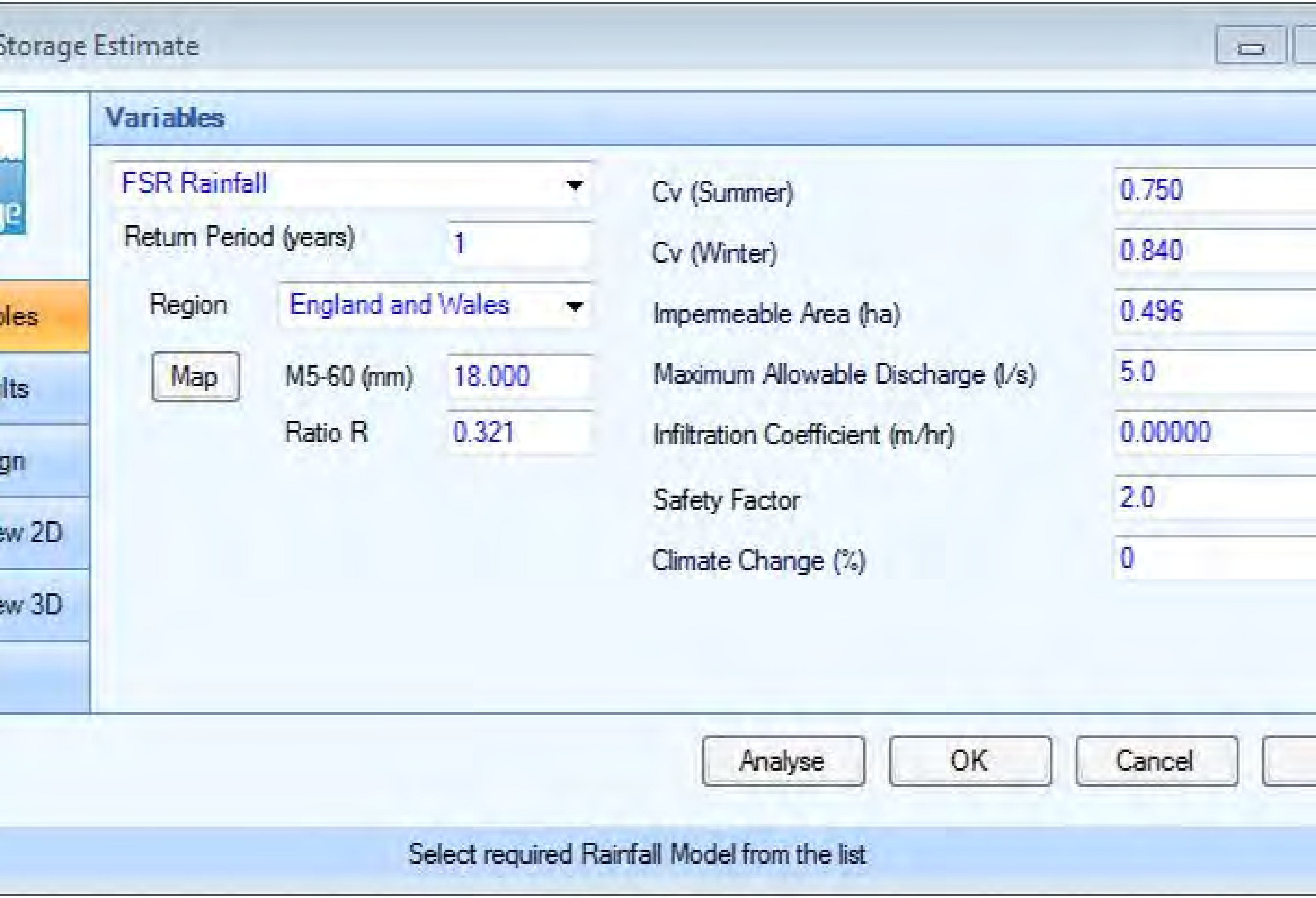
Cancel
Select required Rainfall Model from the list


Storage Estimate
Variables
FSR Rainfall
Return Period (years)
1
Region
England and Wales
Map
M5-60 (mm)
18.000
Ratio R
0.321
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
0.496
Maximum Allowable Discharge (l/s)
5.0
Infiltration Coefficient (m/hr)
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Safety Factor
2.0
Climate Change (%)
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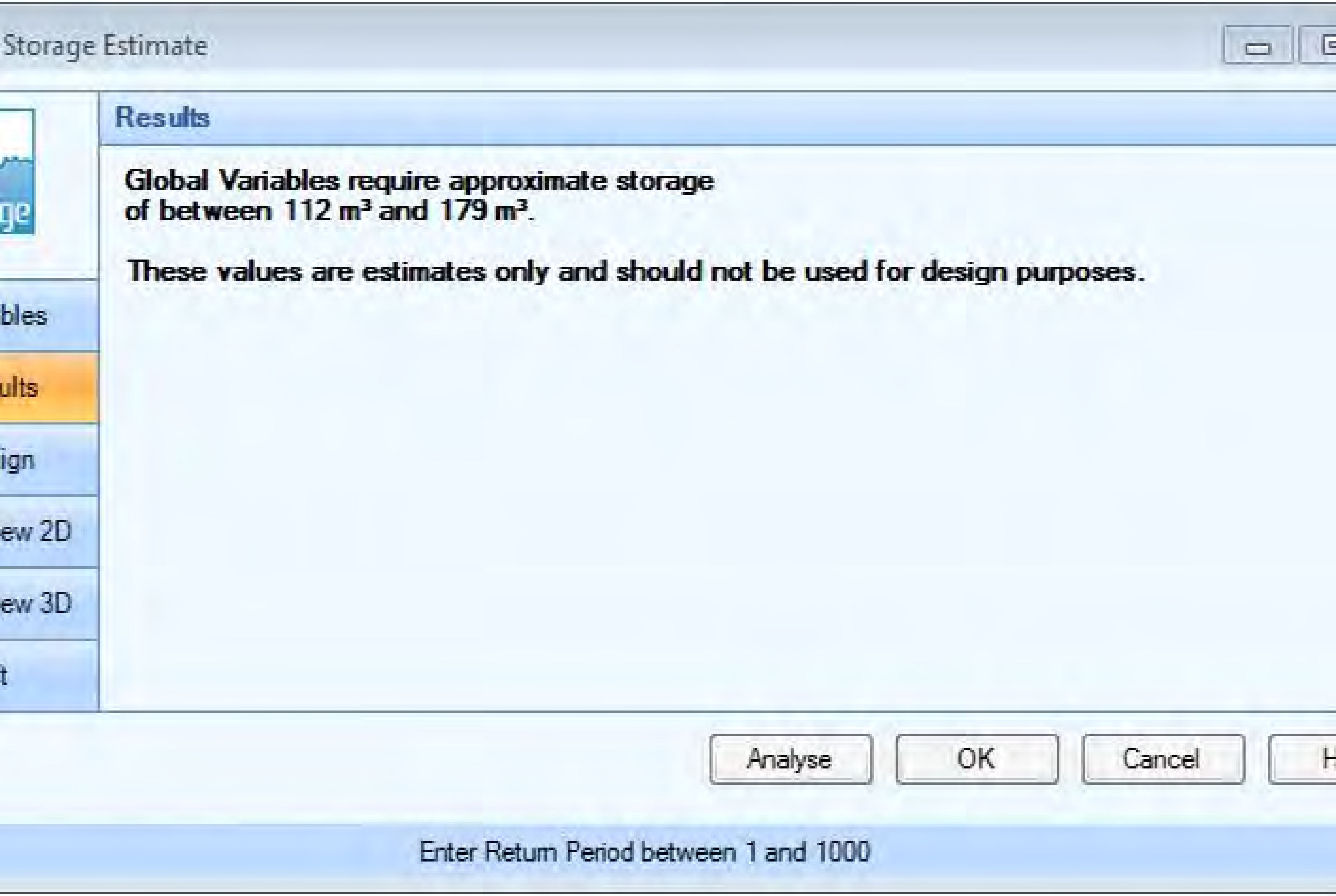
Analyse
OK
Cancel
Select required Rainfall Model from the list


Storage Estimate
Results
Global Variables require approximate storage
of between 112 m³ and 179 m³.
These values are estimates only and should not be used for design purposes.
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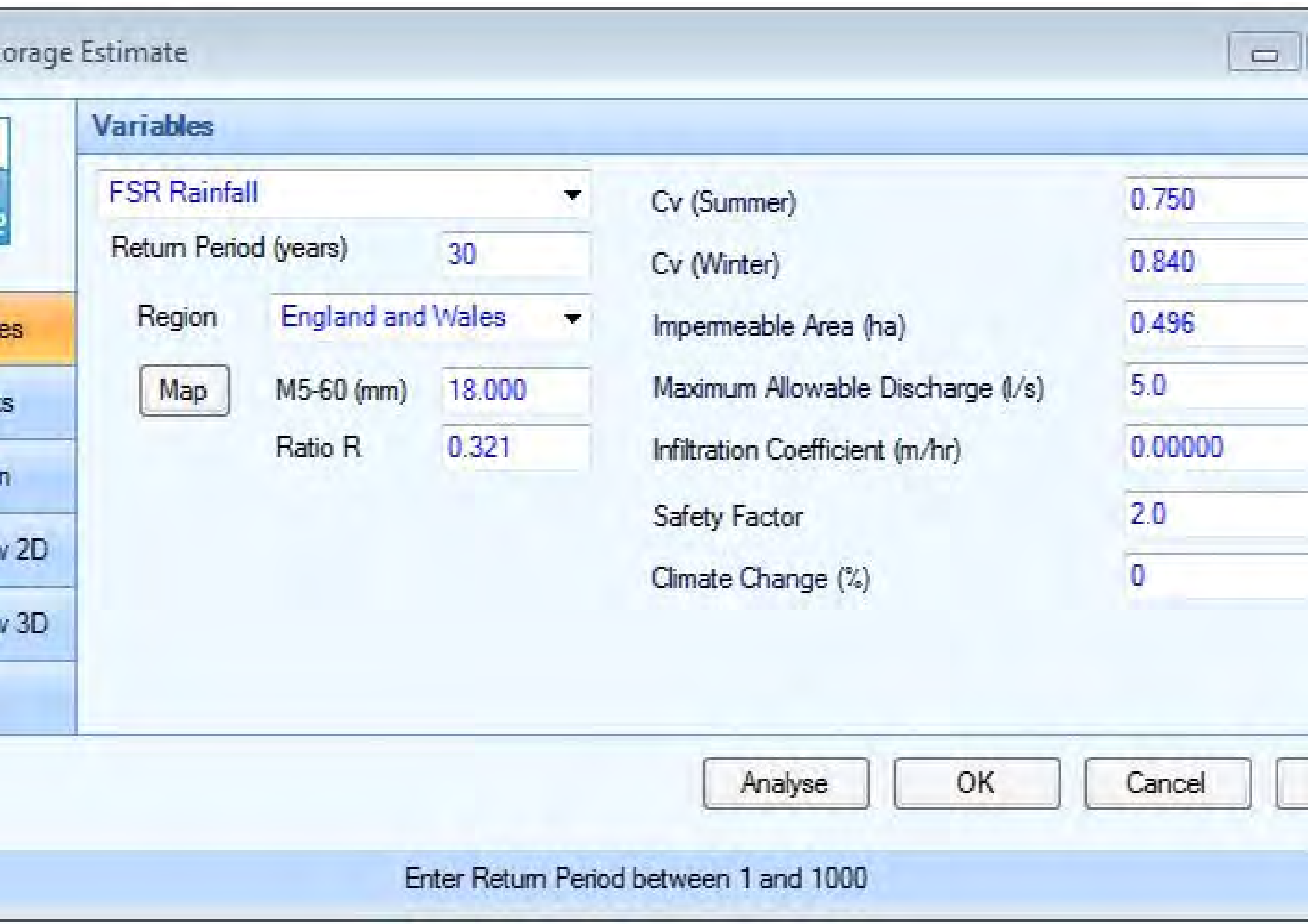
orage Estimate
Variables
FSR Rainfall
Return Period (years)
30
Region
England and Wales
Map
M5-60 (mm)
18.000
Ratio R
0.321
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
0.496
Maximum Allowable Discharge (l/s)
5.0
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
0
Analyse
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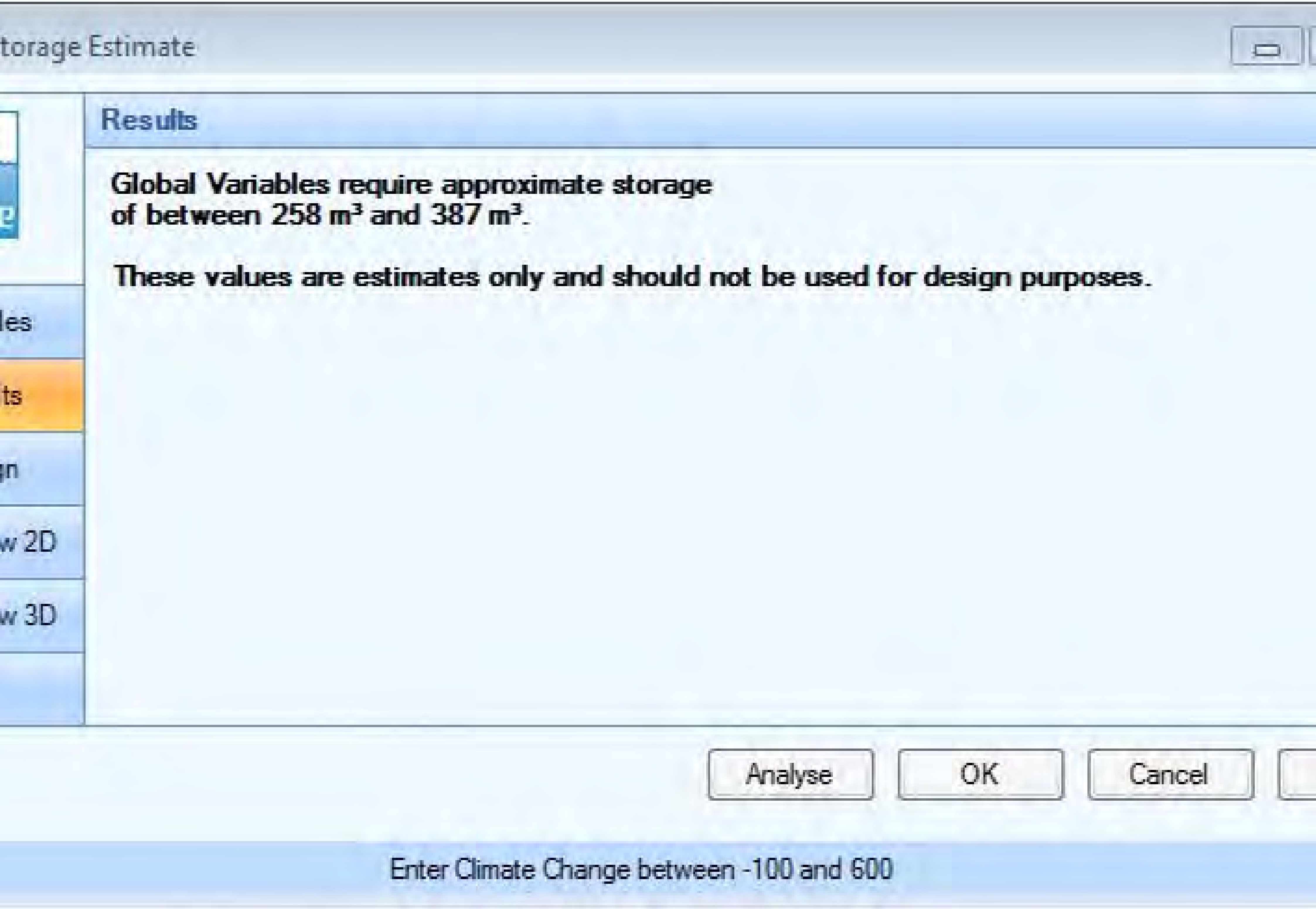
Cancel
Enter Return Period between 1 and 1000



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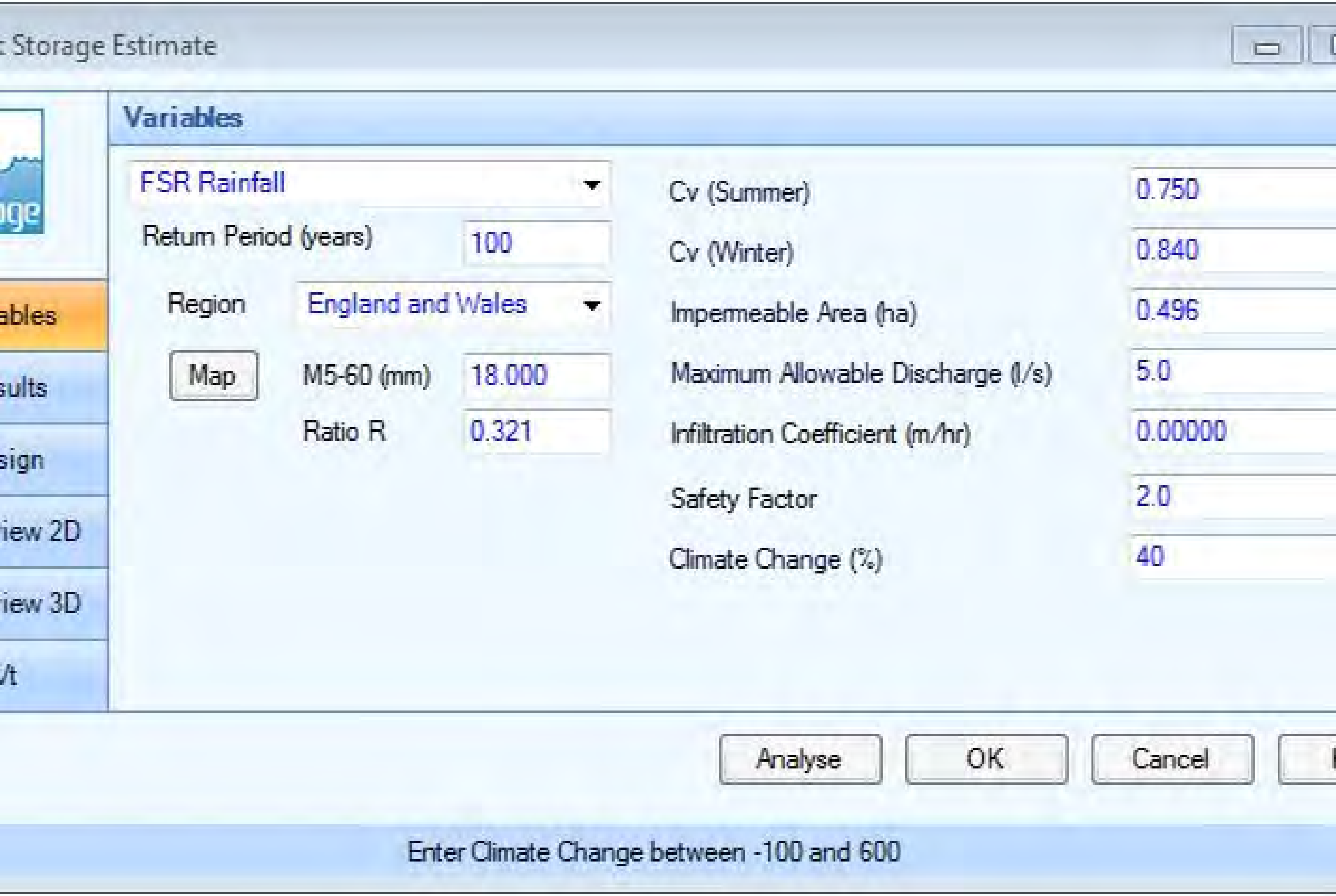
Global Variables require approximate storage
of between 258 m³ and 387 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Enter Climate Change between -100 and 600



Storage Estimate
Variables
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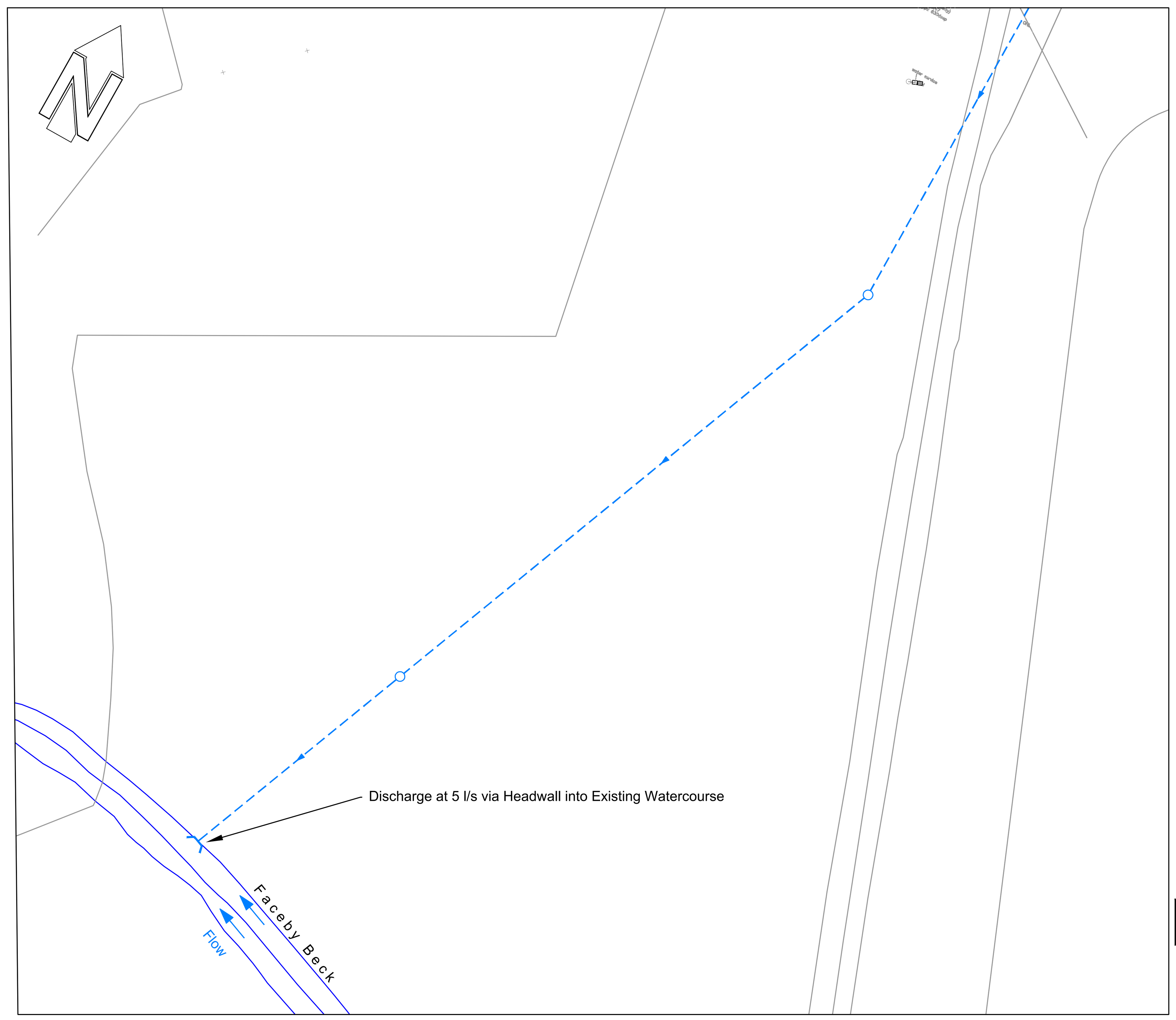
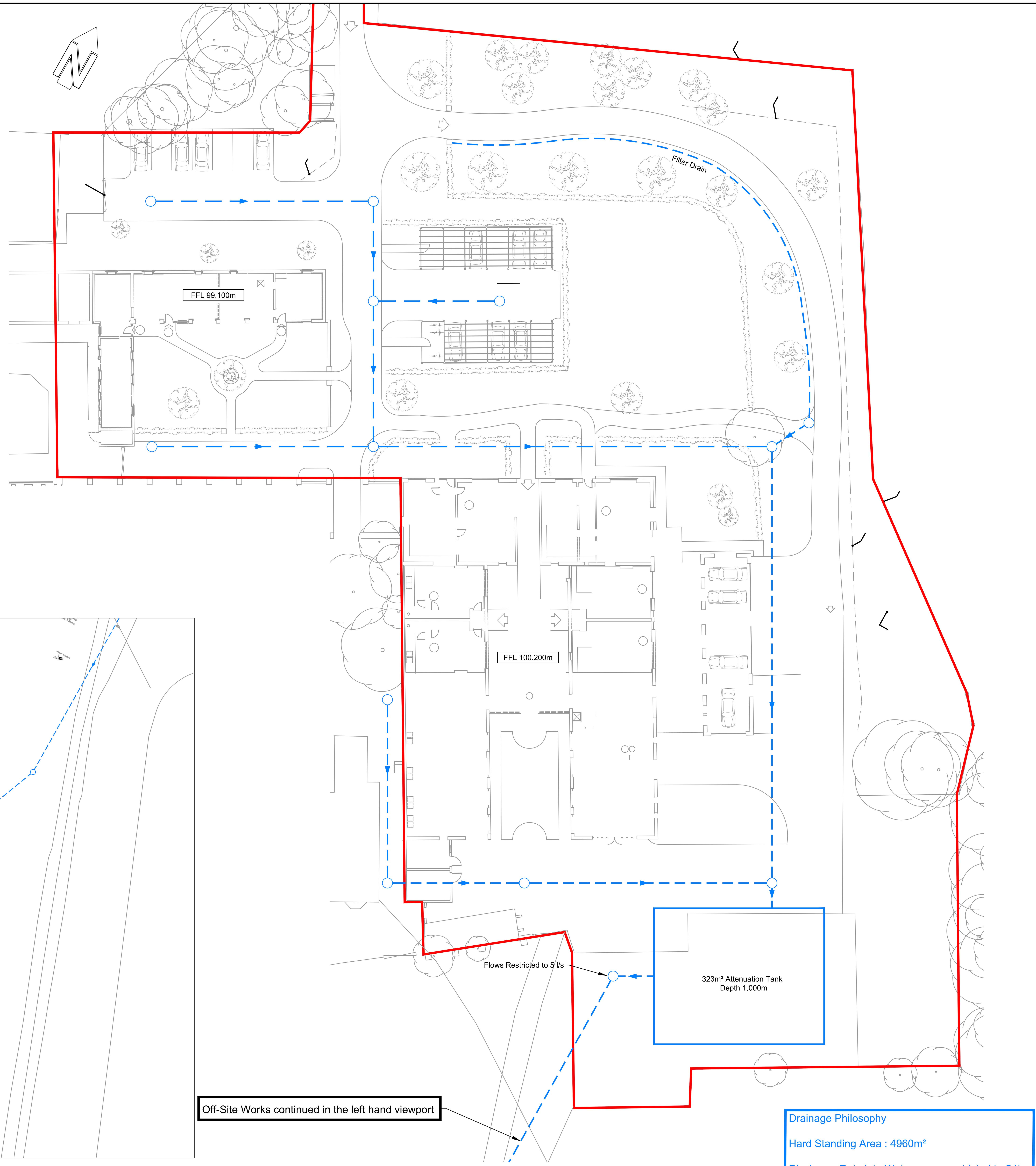
iew 2D
iew 3D
FSR Rainfall
Return Period (years)
100
Region
England and Wales
Map
M5-60 (mm)
18.000
Ratio R
0.321
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
0.496
Maximum Allowable Discharge (l/s)
5.0
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
40
Analyse
OK
Cancel
Enter Climate Change between -100 and 600

Appendix G

Drainage Layout



Proposed Off-Site Works
Scale 1:500



Proposed Drainage Plan
Scale 1:250

Drainage Philosophy

Hard Standing Area : 4960m²

Discharge Rate into Watercourse restricted to 5 l/s

Attenuation Tank with volume 323m³ based on 1 in 100 year +40% climate change

DO NOT SCALE

Notes

1. All levels shown are in metres and are relative to site datum.
2. Invert levels of all existing chambers and connection points are to be confirmed and engineer advised prior to commencement of any drainage works.
3. Concrete bed and surround is required to all gully leads and to all pipes in highways/hardstanding where cover to pipe <1200mm.
4. All pipes to be either extra strength V.C. to BS 65 or PVC to BS 4660 or BS 5481 `UPONOR ULTRARIB' or concrete pipes Class 120 to BS 5911.
5. Exact positions of RWP and PU positions are to be provided on and taken from architects drawings.
6. All Pipes to be assumed as 150Ø unless noted otherwise

Legend

S1 — Proposed SW Drainage (150Ø U.N.O)

Site Boundary Line

AMENDMENT	BY	REV	CHK	DATE
Issued for Information	ZW	P1	SR	21.11.2018

Rev P = Preliminary T = Tender C = Construction LCI = Last Construction Issue

In instances where this drawing completes or partly completes a contract, Billinghurst George & Partners will consider that it's product has been validated, unless in a period not exceeding 90 working days, the client advises to the contrary.

Client
Jomast

Project
Faceby Lodge Farm
conversion of existing buildings

Drawing Title
Schematic Surface Water Drainage Layout

Drawn Z.Waller Date 20.11.2018
Checked S.Ramshaw Date 20.11.2018
Scale As Noted Original Size A1

Billinghurst George & Partners
CIVIL & STRUCTURAL ENGINEERS
BUILDING SURVEYORS
1st Floor, Wellington House, Wellington Court,
Stockton-on-Tees, TS18 3TA

Drg. No. 18T1486-100 Rev. P1

Appendix H

EA Floodmaps

Flood map for planning

Your reference	Location (easting/northing)	Created
Faceby lodge	**449663/504064**	**14 Sep 2018 10:19**

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
Faceby lodge

Location (easting/northing)
449663/504064

Scale
1:2500

Created
14 Sep 2018 10:19

Selected point

Flood zone 3

Flood zone 3: areas benefitting from flood defences

Flood zone 2

Flood zone 1

Flood defence

Main river

Flood storage area

0 20 40 60m

dewpoint.
Energy Services Ltd

LOW OR ZERO CARBON TECHNOLOGIES FEASIBILITY REPORT

FOR

MD2 CONSULTING LTD

PROJECT: FACEBY LODGE FARM, CARLTON-IN-CLEVELAND

DEWPOINT ENERGY SERVICES LIMITED
OCT 2018

Executive Summary

This feasibility study has been carried out by Dewpoint Energy Services to examine the most technically and financially feasible solution for the management and reduction of dwelling carbon emission levels at Faceby Farm, Carlton-in-Cleveland.

Dewpoint Energy Services have a vast experience in undertaking energy assessment and sustainability based projects, and have a sound understanding of the various technologies discussed within this study. The company has no professional connections to a single low or zero carbon technology or manufacturer and is therefore positioned appropriately to be considered an independent energy specialist.

Prepared by:	Checked by:
Lee Mountford	Chris Luk e BSc. (Hon s)
Associat e Director	Directo r
Date: 13th November 2018	Date: 13th November 2018

Rev:	Issue:	Date:
1.0	First Issue	13.11.18

Contents

Appendices

1. INTRODUCTION

This report investigates the different carbon reducing/energy saving options available for proposals at at Faceby Farm, Carlton-in-Cleveland.

The proposed works involve converting existing agricultural buildings into 10No. Holiday Lets. As a result this will cover a mix of existing elements as well some new build elements which will need to be assessed.

This report will examine a variety of carbon reducing strategies that will cover the unit's main heating / domestic hot water systems, ventilation, and potential renewable technologies. It will also investigate the financial viability and practicalities associated with each proposal. In addition to this, we will also provide an overall summary which includes our recommendations.

SAP CALCULATIONS:

One of the key elements in producing this document was the production of SAP Calculations which cover the various energy saving options. SAP calculations are a Building Regulations requirement to demonstrate compliance with Approved Documents L1a and L1b, which covers both new-build and existing dwellings. The Standard Assessment Procedure (SAP) is a measure of the energy efficiency of a property and must be carried out by an accredited assessor.

The first step in putting together our findings was to complete a 'Baseline SAP' calculations, based on the information received by the Project Architects. To produce the Baseline SAP, we have used the U-Values outlined in Table 1 (Windows and Doors) & Table 3 (Upgraded Thermal Elements). We believe that, given the thermal envelope of the existing structures would need to be upgraded, the upgraded figures in these tables would be a minimum requirement for Building Control Approval, and therefore a sound basis for our Baseline SAP. From here, we can then model variation SAP calculations for various renewable technologies to give an indication of their performance.

A 'U-Value' Calculation looks at the thermal efficiency of the external envelope and is a measurement of heat loss through 1 m² of the building fabric when the temperature differs by 1ºC (external vs internal).

For the Baseline SAP we have included the following U-Values:

• Upgraded Floor	0.25 W/m2K
• Upgraded Walls	0.30 W/m2K
• Upgraded Roofs Cold	0.16 W/m2K
• Upgraded Roofs Warm	0.18 W/m2K
• Flat Roof (Balcony)	0.18 W/m2K
• Glazed Elements (Windows/Glazed Doors/Glazed Links)	1.6 W/m2K
• Doors (Solid/Half Glazed)	1.8 W/m2K

Given there are multiple units on the proposals, we have produced 3 No. baseline SAP Calculations to give an idea of the differences in performance. When producing the SAP Calculations for the proposed renewable technologies, they will all be produced for the 3 No. units in question. The following units were selected, given their differences in size and orientation:

- Unit 4
- Unit 5
- Unit 7

Other elements that have been included in the Baseline SAP calculation are a dwelling Air Permeability Rate and a proposed heating system. Air permeability is a measurement of how much air permeates through the building envelope (m²) in an hour, when the dwelling is pressurised to 50 Pa. This test will then yield a result, and the maximum permitted result for Building Regulations part L compliance is currently 10m3/hm2(@50Pa). We have used this max permitted air permeability figure in our baseline SAP Calculation. The ventilation systems have been assumed to be natural with extract fans to kitchens and bathrooms. With regards to the heating systems of the units, we have taken for electric radiant panel heaters for all Baseline SAP Calculations. Normally a gas boiler would have been used, but the Utilities Report (see below) confirms there is no gas supply to the site, and therefore electricity powered heating would need to be used.

From these Baseline SAP Calculations, we are able to produce SAP DER worksheets, which show the Dwellings Carbon Emission Rates. These have been supplied as Appendixes to this document to demonstrate the performances of each unit. We can then compare the DER Baseline of each unit against the various renewable technology SAP Calculations, to see what difference the different technologies make.

Please refe r to Appendix A for Baseline SAP DER Worksheet s.

NATIONAL PARK DOCUMENTS AND POLICIES:
Given that the proposals lie within the National Park, then the guidelines and polices of the National Park must therefore be adhered to. Some areas of the National Park Policy deal directly with Climate Change Mitigation & Adoption as well as Renewable Energy, and these documents have been considered when putting together our recommendations. Specifically, we consider the following Policies relevant:

- Adopted Core Strategy & Development Policies.
    - Core Policy A - Delivering National Park Purposes and Sustainable Development.
    - Core Policy D - Climate Change.

- Draft Local Plan (at Preferred Options Stage).
    - Strategic Policy F - Climate Change Mitigation and Adaption.
    - Policy ENV8 - Renewable Energy.

- North Yorkshire Moors National Park Authority Renewable Energy Supplementary Document

These policies outline the stance of the National Park in relation to renewable technologies, as well as outline any design/appearance considerations that are to be factored.

It is also noted that Policy ENV8 states: Requiring residential proposals of five units or more and other uses of 200 sqm or more to generate energy on-site from renewable sources to displace at least 10% of predicted CO2 emissions.

Given this stipulation, we have ensured that all renewable technology options investigated in this report are done so by ensuring they displace 10% or more of the CO2 emissions outlined in the Baseline SAP Calculations.

Both the need for 10% CO2 displacement via renewable technologies, plus the various leanings of the National Park towards each, has helped us shape our recommendations in this report.

AVAILABLE UTILITIES:
A full Utilities report has been carried out and appended to this report (please refer to Appendix F-Utilities Report). However, the main point of interest that the report shows is that there is no gas supplied to the site. It would be impractical, and extremely expensive, to try and install a gas supply, so we have instead discounted anything that required gas. With this in mind, we have used Radiant Electric Panel Heaters as the primary heating source in the Baseline SAP Calculations, in lieu of a standard gas-powered boiler.

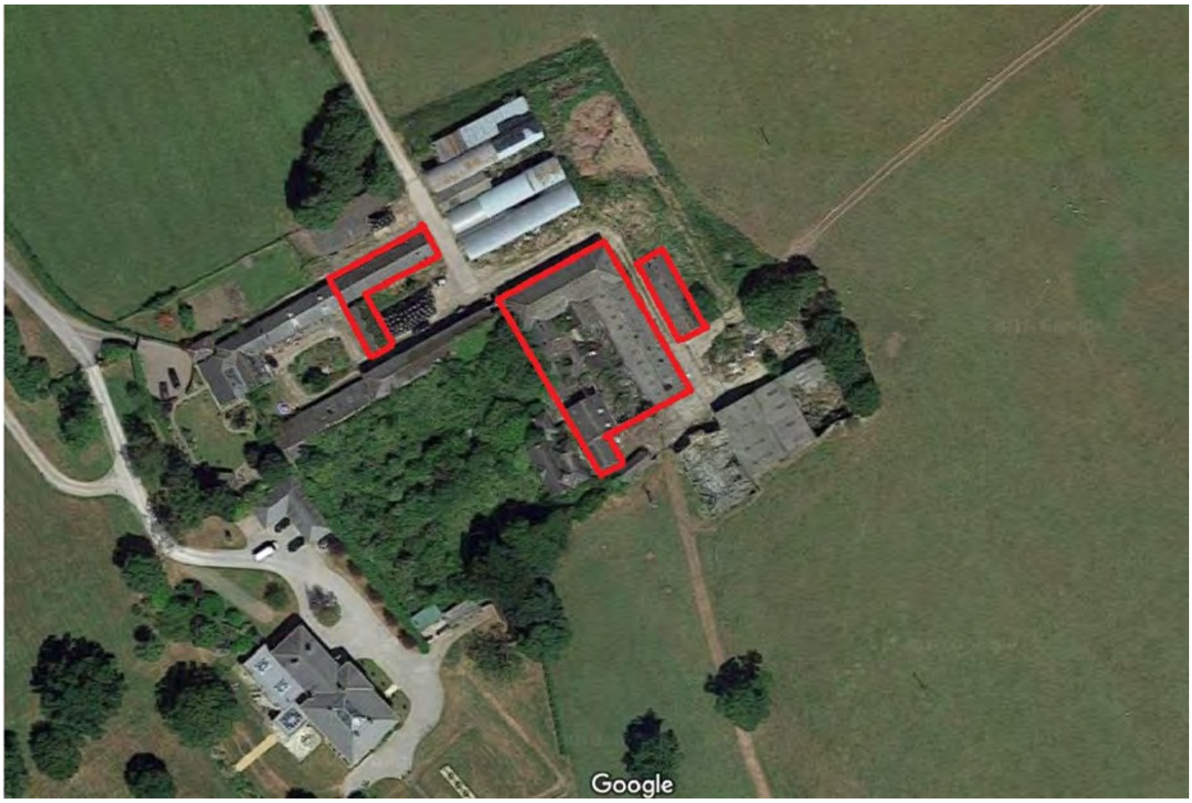
ASSOCIATED COSTS:
As part of this report, we have looked into costs associated with each renewable technology and have advised on each. Whilst it is important to note that we have tried to be as accurate as possible, the cost of installing each technology could vary a great deal depending on what offers are available from manufacturers at the time of installation. The costs show in this report are therefore to be taken as a guide to help inform decision making on the viability of each technology.

When forming our recommendations in this report, all of the above factors have been taken into consideration and helped shape our conclusions.

2. SITE LAYOUT AND LAND USE

The proposed site is located in Faceby, Carlton-in-Cleveland, and is accessed off the A172 Road North of Bank Road. The site itself is predominantly agricultural use; and some of the existing agricultural buildings are being converted to form the 10No. holiday lets as part of this project (highlighted in red on Fig 1).

Fig. 1: Proposed Site Location Plan – Faceby Farm, Carlton-in-Cleveland



3. RECOMMENDED RENEWABLE ENERGY OPTIONS

Following the production of the Baseline SAP calculation for the proposals, we produced a number of SAP simulations which examined various energy/carbon savings options, utilising Low or Zero Carbon Technologies (LZCs), and investigated how suitable each was for this development. This section of the report includes a review of the available LZC Technologies and their suitability.

The following is a list of technologies considered potentially suitable for integration into this development:

- Solar Photovoltaic Panels (PV)
- Air Source Heat Pumps (ASHP)
- Ground Source Heat Pump (GSHP)
- Biomass Boilers

Any technologies deemed unsuitable for this site together, along with their appraisal, are detailed in section 4 of this report. These include:

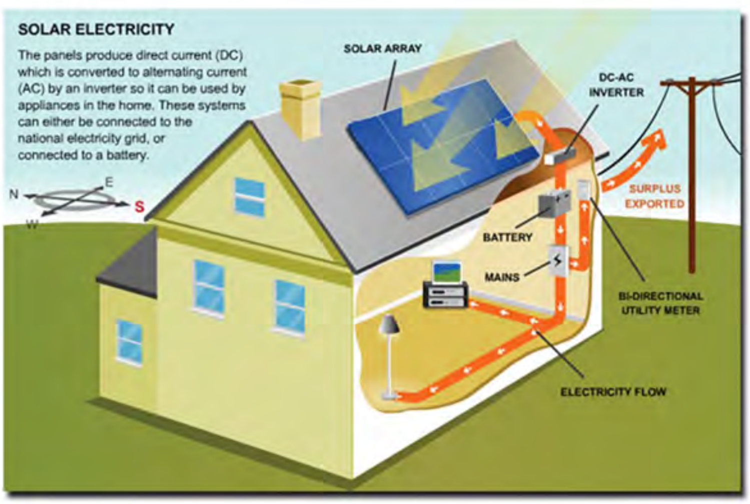
- Balanced Whole House Mechanical Ventilation with Heat Recovery (MVHR)
- Flue Gas Heat Recovery Unit (FGHR)
- Solar Thermal Domestic Hot Water Panels (STHW)
- Combined Heat and Power (CHP)
- Micro Wind Turbines (MWT)

3.1 Solar Photovoltaic Panels (PV) – General Overview

Solar Photovoltaic panels comprise of interconnected PV cells which can be affixed to the roof or walls of a building, or be ground mounted locally. Each cell is constructed from one or two layers of semi-conducting material, usually silicone. When light shined on the cell it creates an electric field across the layers. The more sunlight received by the panel, the more electricity is generated. PV cells come in a variety of shapes and colours, ranging from grey 'solar tiles' designed to substitute and appear line traditional roof tiles, to panels and transparent cells that can be applied to conservatories and areas of glass. The rate output of a PV panel if generally measured in Kilowatt Peak (kWp) under standard test conditions (STC).

Source:Energy Saving Trust; http://www.energysavingtrust.org.uk/Generate-your-own-energy/Solar-electricity

Fig. 2: Solar Photovoltaic Panels – How it Works



Source:http://www.o2heatpumps.com/solarelectricpv/howphotovoltaicpvworks.aspx

3.1.1 Solar Photovoltaic Panels (PV) – Faceby Farm Suitability

The pitched roof configurations on the different units vary, giving different orientations to different units. All roof slopes have been modelled at approx. 30º pitch to the horizontal, however, given the different orientations, if the panels were to be roof mounted, the units would not expect uniform results. The array will be connected to the mains electricity circuit within the dwelling via a DC to AC inverter. This arrangement will ensure that the panels have good solar access, and benefit from unobstructed views of the sky. The output of a PV panel will also vary by type and model.

When compared against the Baseline SAP's, and assigning 3kWp to each of the tested units, we can see the following improvements:

Unit 4 – 29.67% improvement in CO_2 emissions.

Unit 5 – 75.09% improvement in CO_2 emissions.

Unit 7 – 11.39% improvement in CO_2 emissions.

Please refe r to Appendix B for Solar PV SAP DER Worksheet s for furt her inf ormation .

Further consideration is to be considered on the location of the PV panels and how they fit in with National Park Policy. The North Yorkshire Moors National Park Authority Renewable Energy Supplementary Document, when referencing Solar Thermal and PV Panels, states:

Because of their particularly modern, industrial look solar installations may be well suited to agricultural buildings, industrial buildings and contemporary buildings, however their use on domestic or traditional properties should not be ruled out provided satisfactory siting and design can be achieved. In some instances it will not be possible to locate solar installations on Listed Buildings or within Conservation Areas without harming their character and therefore alternative renewable technologies should be investigated.

Because of its flat, dark-coloured surface, solar is most likely to be acceptable on buildings with slate roofs, or in the case of new buildings in areas where slate roofs are characteristic of the area. Panels can be installed so that they are flush to the roof.

Given the nature of this scheme – the conversion of existing agricultural buildings – and also that the proposed roof is to be slate, then it is considered that Solar Panels could be a viable option, especially when considered with initial planning comments on a previous scheme for this site:

There is also a requirement under Core Policy D for residential development of 5 or more houses and other uses of 200sqm or more to generate energy on site from renewable sources to displace at least 10 per cent of the predicted CO_2 emissions. Perhaps air/ground source heat pumps or ground mounted solar panels may be a feasible option.

If roof mounted panels are seen as unfavorable by the National Park Authority, then it is possible to have the panels ground mounted, and given the sites proximity to the nearest road, (the A172) then it is unlikely they would be seen. However, there is also the possibility of screening if required, but it would need to be done in such away as to not affect the efficiency of the panels.

Given that 3kWp would seem to be the maximum we would need to assign to a unit to hit the 10% improvement in CO_2 emissions target (see results above for Unit 7), the proposals can therefore investigate lowering the amount required for smaller units (as Unit 7 is the largest).

Installation for Solar PV Panels are usually in the region of:

1 kWp - £ 1,500
2 kWp - £ 3,000
3 Kwp - £ 5,000

A full PV design would be required once the construction specification is developed and finalised to determine exactly how many panels are need to achieve the required output, but at this stage it is reasonable to assume, based on the figured above and averaging 2 kWp required for each unit, that estimated total costs for Solar PV would be in the region of £30,000.

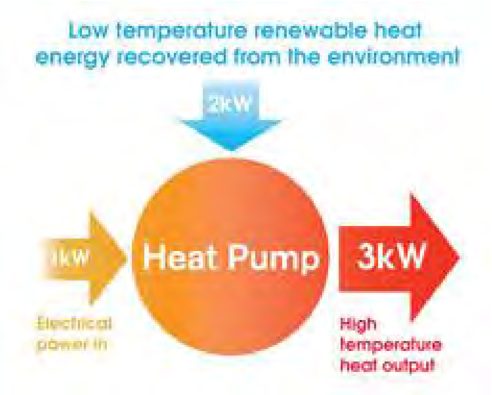
RECOMMENDED
Whilst a full PV design would be required once the schemes details and specifications are finalized, it is reasonable to assume, given the information available at this stage, that Solar

Photovoltaic Panels are a viable option to achieve the 10% displacement of CO2 emissions required by the National Park Authority. Installation costs could be seen to be quite high, but this is to serve 10 No units. In addition, given the guidelines laid out in National Park Policy, and also taking into consideration previous feedback, we feel that this technology is suitable for the site and a viable option to achieve the required targets.

3.2 Air Source Heat Pumps (ASHP) – General Overview

An air source heat pump extracts both sensible and latent heat from external air for heating an indoor environment via a reverse-refrigeration cycle. Outdoor air is drawn through a heat exchanger (the evaporator) where it is chilled by the refrigeration process and returned to the outdoors. The heat extracted from the chilled outdoor air is then transferred by the refrigerant and used to provide space heating via compression and a second heat exchanger (the condenser) that circulates either indoor air or a fluid (air-to-water).

Fig. 3a & 3b: Air Source Heat Pump – Heat Pump Chart (left) & In-situ ASHP (right)



Source: http://www.renewableenergysystemsuk.co.uk/Air_Source_Heat_Pumps/East_Sussex/
http://www.aspen-ac.co.uk/air-source-heat-pumps.html

The efficiency of air source heat pump systems is measured by a coefficient of performance (COP) which describes the amount of heat it generates compared to the amount of electricity it consumes. A typical COP for an air source heat pump is around 2.5 [2]

2. Energy Savings Trust; http://www.energysavingtrust.org.uk/Generate-your-own-energy/Air-source-heat-pumps

3.2.1 Air Source Heat Pumps (ASHP) – Faceby Farm Suitability

The ASHP units should be mounted either externally or within a suitably ventilated space. The ideal location for these units would be outside the property mounted on an external wall or floor near to the dwelling. Suitable screening or acoustic treatment may be required subject to the requirements of the project acoustic consultant (if required). Due to the nature of the existing structures, finding suitable locations may be a challenge (they could be mounted in the courtyard side or, more likely, to the back of each unit). and it is also noted that Air Source Heat Units are not silent when in operation. This may would be something to take into consideration, especially given the nature of the units (holiday lets) – is it could put people off who are considering letting them.

The North Yorkshire Moors National Park Authority Renewable Energy Supplementary Document, when referencing Air Source Heat Pumps, are not against them, but do highlight their industrial appearance and the probable requirement for screening.

It must also be considered that in order to maintain a high seasonal COP the flow temperatures must be kept to a minimum. Therefore, for space heating, heat pumps are most effective when connected to large, low temperature emitters, i.e. underfloor coils or radiant panels. They can be used to provide pre-heating of hot water, however, where they are used to provide hot water at 60ºC, their efficiency is reduced significantly.

When compared against the Baseline SAP's, Air Source Heat Pumps perform very well, giving the following improvements:

Unit 4 – 80.06% improvement in CO_2 emissions.

Unit 5 – 80.60% improvement in CO_2 emissions.

Unit 7 – 81.83% improvement in CO_2 emissions.

Please refer to Appendix C for Air Source SAP DER Worksheets.

Installation costs for this would typically be £7,000 (approx.) each, meaning a total outlay in the region of £70,000+ might be expected. Obviously this could be significantly reduced depending on any deals available, but it would prove a an expensive option.

RECOMMENDED

The improved CO_2 emissions gained by this technology, coupled with the favorable guidance feedback from the National Park Supplementary Document, means this is a technology feasibly to this scheme, and is therefore has to be recommended for consideration. However, this has to be weighted against the steep capital cost outlay, and the consideration that additional cost could be incurred via any screening needed. It could also be a challenge to find suitable locations for all the units.

3.3 Ground Source Heat Pumps (GSHP) – General Overview

Similarly to an ASHP unit, a GSHP extracts heat from a low temperature source and uses a reversed refrigeration cycle to increase this heat for tempering indoor environments. Close-loop ground source heat pumps circulate a water/anti-freeze mixture through a network of pipes to absorb heat from the ground. These are buried either horizontally in a shallow trench at a depth of between 0.6m and 2.0m, or vertically in one or more boreholes between 15m and 180m in depth. The size and configuration of the collectors are dependent on the heat load, the type of the ground and how much is available for use. While initial ground-work costs are higher than for air source, heat pumps of an equivalent capacity, capacity losses through periodic defrost and a reduction of ambient temperatures are avoided.

It should be considered that the heat in the ground is a finite resource. Although this resource is recharged by absorption of solar radiation, if the heat pump extracts heat at too high a rate, the average ground temperature will fall and energy available will be reduced. This situation can be prevented by ensuring that the ground loop, or bore hole is sufficiently sized to enable a thermal balance annually.

Fig. 4a & 4b: Ground Source Heat Pump –
GSHP Typical System (left) & In-situ GSHP Slinky Pipe Run (right)

Source: http://www.uk.heatpumps.danfoss.com/Content/85FA07ED-92D4-46E1-AD70-E95B4AE82344.html
http://www.ramseyecoheating.co.uk/heatpumps.htm

3.3.1 Ground Source Heat Pumps (GSHP) – Faceby Farm Suitability

The GSHP units should be located within a sheltered environment and as near to the dwelling as possible to minimize losses through the pipe work. There would be adequate space available on the development to install a horizontal pipe 'slinky' configuration, which would be the preferred method. A vertical borehole configuration could be installed subject to an engineer's suitability report for the development site. It must be considered that in order to maintain a high Seasonal COP the flow temperatures must be kept to a minimum. Therefore, for space heating, heat pumps are most effective when connected to large, low temperature emitters, i.e. under floor coils or, radiant panels.

Given the space available for GSHPs to the units, we would advise a bore hole system is required on this project, but a specialist GSHP designer / manufacturer could advise further.

When compared against the Baseline SAP's, Ground Source Heat Pumps perform the same as Air Source Heat Pumps, giving the following improvements:

Unit 4 – 80.06% improvement in CO_2 emissions.

Unit 5 – 80.60% improvement in CO_2 emissions.

Unit 7 – 81.83% improvement in CO_2 emissions.

Please refer to Appendix D for Ground Source SAP DER Worksheets.

Installation costs for GSHP's would work out at approx. £14.5K per unit, and would require bore holes given the limited amount of central land (comparable to the units). The costs therefore for the while scheme could easily be in the region of £150,000.

RECOMMENDED

Similarly to ASHP, ground source heat pumps also offer high efficiency and a relatively low carbon alternative for space heating, however, the heat pump needs to be sized accordingly in order to provide a 60+ºC hot water demand. If this is not achieved an electric immersion heater or a high temperature cycle would be required to raise the domestic hot water to 60+ºC. Space restrictions are normally an issue for horizontal laid pipework, and careful consideration would need to be given to this – given we may need a bore hole system, this could be advantageous. Only a fully designed system could determine if this is feasible given the current site constraints. GSHP perform just as well as the ASHP and have the benefit of not being visible, so there should be no conflict in regards to the National Park Policies. However, it is noted that, like ASHP, the expense of such a technology on this site, to serve 10No units, is quite high.

3.4 Biomass Boiler

Biomass refers to any plant-derived, organic material that renews itself over a short period. Biomass energy systems are based on either the direst or indirect combustion of fuels derived from those plant sources. The most common form of biomass is the direct combustion of wood in treated or untreated forms. Other possibilities include the production and subsequent combustion of biogas produced by either gasification or anaerobic digestion of plant materials. Liquid biofuels such as bioethanol can also be used. The use of biomass is becoming increasingly common in some European countries (some countries such as Austria are heavily dependant on biomass). The environmental benefits relates to the significantly lower amounts of energy used in biomass production and processing compared to the energy released when they are burnt. This can range from a four-fold return for biodiesel to an approximate 20-fold energy return for woody biomass.

A biomass fuel boiler could be installed in place of a conventional gas heating boiler to achieve a significant reduction in Co_2 emissions. The Co_2 Emissions conversion factor for Biomass wood pellets (bulk delivery) being 0.039kgCo_2/kWh in comparison to 0.519kgCo_2/kWh for standard tariff electricity.

3.4.1 Biomass – Faceby Farm Suitability

The development would benefit greatly from the CO_2 reductions associated with running Biomass boilers as the primary heating systems. There seems to be adequate space within the site boundary to house Biomass fuel, such as wood logs, wood chips or bulk wood pellets; however, these need to be housed within a suitable store, and this would need to be a structure agreed with the National Park Authority. Perhaps one of the existing structures could be converted to such? Access into the site is a little tight for Biomass fuel delivery vehicles, however, given the intermittent nature of deliveries, the disruption is likely to be minimal.

Please refer to Appendix E for Biomass SAP DER Worksheets.

When compared against the Baseline SAP's, Biomass performs exceptionally well, giving the following improvements:

Unit 4 – 138.74% improvement in CO_2 emissions.

Unit 5 – 121.20% improvement in CO_2 emissions.

Unit 7 – 151.23% improvement in CO_2 emissions.

Installation costs for this would typically be £105,000 (approx.) based on a commercial system, which would be required for the 10 total units (including all pipework, wet system & cylinders).

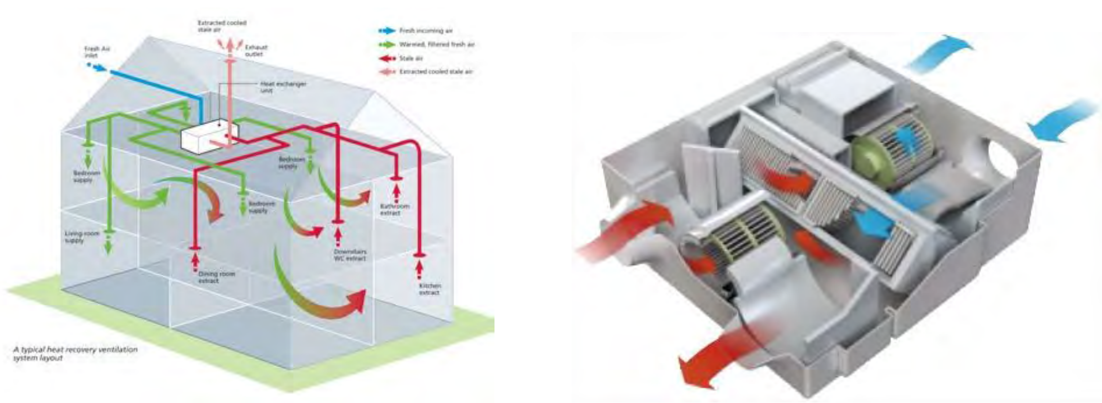
RECOMMENDED
This biomass option provides the greatest carbon savings, compared with the alternative solutions previously discussed. This fact alone means Biomass should be given serious consideration. Some potential issues could arise in the need for a suitable storage area for the fuel, as well as vehicle access should large delivery vehicles be needed, as well as the high initial cost outlay required.

4. EXCLUDED ENERGY OPTIONS

4.1 Balanced Whole House Mechanical Ventilation with Heat Recovery (MVHR)

MVHR provides both the input of constant delivered fresh air and the extract of warm stale air from the dwelling via a concealed ductwork system. These systems utilize a plate heat exchanger to recover the latent heat from the extracted warm stale air, which is normally extracted from the kitchen and any other 'wet room', and is used to pre-heat or temper the incoming fresh air. Therefore adequate ventilation is supplied to the dwelling as well as reducing the load on the primary heating system, when compared to traditional natural ventilation. The energy saved is designed to offset the energy consumption of the fan and the associated CO_2 emissions. Where the design air permeability rate of the dwelling is significantly reduced through high levels of air tightness, mechanical ventilation is recommended to ensure that a suitable air change rate is maintained within occupied and other 'warm' spaces. In the case of dwellings that are built to PassivHaus standards <0 $m^3/h/m^2$@50Pa air permeability rate, MVHR must always be specified to avoid the issue of Sick Building Syndrome.

Fig. 5a and 5b: MVHR system schematic (left) & MVHR heat recovery unit (right)



Source:http://www.wholebuild.co.uk/building-product/part-f-ventilation/case-studies/housing-association-tackles condensation-with-mvhr-system

EXCLUDE
This technology does not offer much in the way of improvements to the existing dwelling (if any) due to the probable air leakage through any retained existing fabric. This would counteract any gains made. In addition, the ductwork would most likely need to be surface fixed which may cause potential obstruction issues. For these reasons we cannot recommend this technology alone. Its only possible benefit would be used in conjunction with a Fabric First Approach, which would limit potential air leakage. Even so, achieving the 10% CO2 displacement gains with this technology alone would not be feasible.

4.2 Flue Gas Heat Recovery Unit (FGHR)

The FGHR Unit works by being fitted to the flue adaptor on top of a combination boiler and recycles any waste heat before it gets expelled through the flue and is lost to the external environment.

The heat recovered from the flue exhaust gases is then used to pre-heat the incoming cold mains water supply before entering the boiler, thereby reducing gas consumption and improving domestic hot water efficiency.

The device is particularly effective during the winter months when energy demands are at their highest. This is because, as the boiler consumes more gas, the FGHR Unit recovers more waste energy cutting fuel bills and reducing CO_2 emissions.

1. Boiler Guide: http://www.boilerguide.co.uk/passive-flue-gas-heat-recovery-devices-to-improve-energy-efficiency-and-lower-costs

Fig. 6: Flue Gas Heat Recovery – Typical Boiler Installation

Source: EST; Passive Flue Gas Heat Recovery Devices and Systems

Flue Gas Heat Recovery Units are classed as a low carbon technology, as its maintenance free, requires no controls or has any moving parts, and should only take approximately 30mins to install, by a Gas Safe Registered installer.

The device provides annual savings of around 37% of the energy required to deliver the hot water.

EXCLUDE
As there is no gas supply to the site in question, this technology can be discounted out of hand. Even if gas had been available, this technology alone could not achieve the 10 CO_2 displacement required.

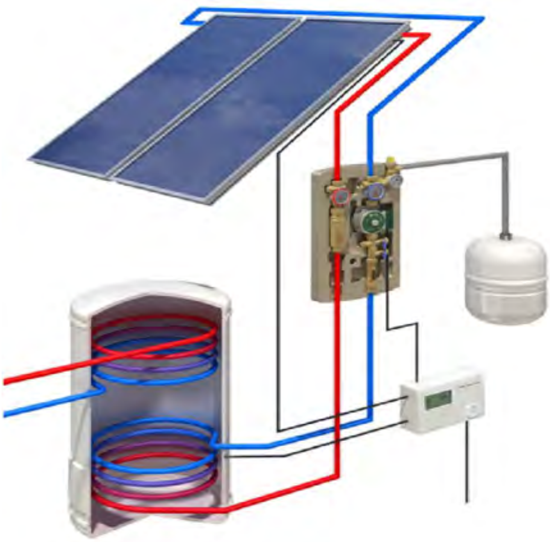
4.3 Solar Thermal Domestic Hot Water Panels (STHW)

Solar Thermal systems use energy directly from the sun to heat hot water, most commonly for domestic hot water needs (such as washing and cleaning requirements). Solar heating systems utilize heat collectors which are usually mounted on a roof, in which fluid is heated by the sun and circulated around the system. The heat from the circulated fluid is then transferred to stored water via a coil within either a dedicated pre-heat vessel or as part of a twin-coil single storage DHW cylinder, as a proportion of the overall cylinder volume.

A typical 3-4 bed domestic installation comprising of approx. 5m² collector area, can provide between 50% and 70% of the total annual domestic hot water requirement, although this will depend on both the quantity and time at which hot water is required. The solar contribution to a buildings domestic hot water supply (DHW) can be increased if hot water is drawn off during the day, providing residual heat storage capacity during daylight hours. Similarly with all solar collection technologies, the energy output is directly proportional to the solar irradiance received. Therefore, the annual yield from a system installed in the Southeast of England will be greater than an identical system installed in the North of Scotland.

The energy savings from a solar thermal water heating system will depend on a large range of factors. The Energy Efficiency Commitment Scheme bases savings from solar water heating on an average figure of 454kWh/m² per annum for flat plate collectors and 582kWh/m² per annum for evacuated tube systems.

Fig. 7: Solar Thermal Domestic Hot Water Panels – Domestic Solar Heating System



Source: http://www.ufw.co.uk/products-technologies/energy-collection/solar/solar-thermal-for-hot-water-production

Similar to what was noted under the previous section regarding Solar PV, the same issue applied with the pitched roof configurations on the different units varying. All roof slopes have been modelled at approx. 30º pitch to the horizontal, however, given the different orientations, the units would not expect uniform results. It should also be noted that, unlike Solar PV, the Solar Thermal Panels would have to be roof mounted, as having them mounted on the ground to serve all units would reduce the effectiveness to the point they would not be efficient. In addition, the appearance of the more efficient evacuated tube collectors is likely to be seen as unacceptable in an area such as The National Park, given their policy guidelines, so only the less efficient flat plate collectors have been considered.

When compared against the Baseline SAP's, and using the flat plate collectors, we can see the following improvements:

Unit 4 – 10.39% improvement in CO2 emissions.

Unit 5 – 24.46% improvement in CO2 emissions.

Unit 7 – 4.58% improvement in CO2 emissions.

As with the Solar PV Panels, further consideration is to be considered to how Solar Thermal Panels fit in with National Park Policy. The North Yorkshire Moors National Park Authority Renewable Energy Supplementary Document, when referencing Solar Thermal and PV Panels, states:

Because of their particularly modern, industrial look solar installations may be well suited to agricultural buildings, industrial buildings and contemporary buildings, however their use on domestic or traditional properties should not be ruled out provided satisfactory siting and design can be achieved. In some instances it will not be possible to locate solar installations on Listed Buildings or within Conservation Areas without harming their character and therefore alternative renewable technologies should be investigated.

Because of its flat, dark-coloured surface, solar is most likely to be acceptable on buildings with slate roofs, or in the case of new buildings in areas where slate roofs are characteristic of the area. Panels can be installed so that they are flush to the roof.

Given the nature of this scheme – the conversion of existing agricultural buildings – and also that the proposed roof is to be slate, then it is considered that Solar Thermal Panels could be a viable option, especially when considered with initial planning comments on a previous scheme for this site but, as stated previously, they would have to be roof mounted. In addition, the more efficient evacuated tube panel collectors would have an appearance (where the tubes are uncovered and visible) adverse to National Park Policy.