THREE SCORE PHASE 2| NORWICH

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1.0 | Three Score Masterplan

In June 2013, outline planning permission was secured for 1,000 homes, community facilities, a care home and open space on the 32-hectare site in Bowthorpe, Norwich.

The outline application provides over 10 hectares of public open space, retains existing features such as important tree belts and hedges and also proposes a network of cycle and walking routes across the site.

PHASE 1

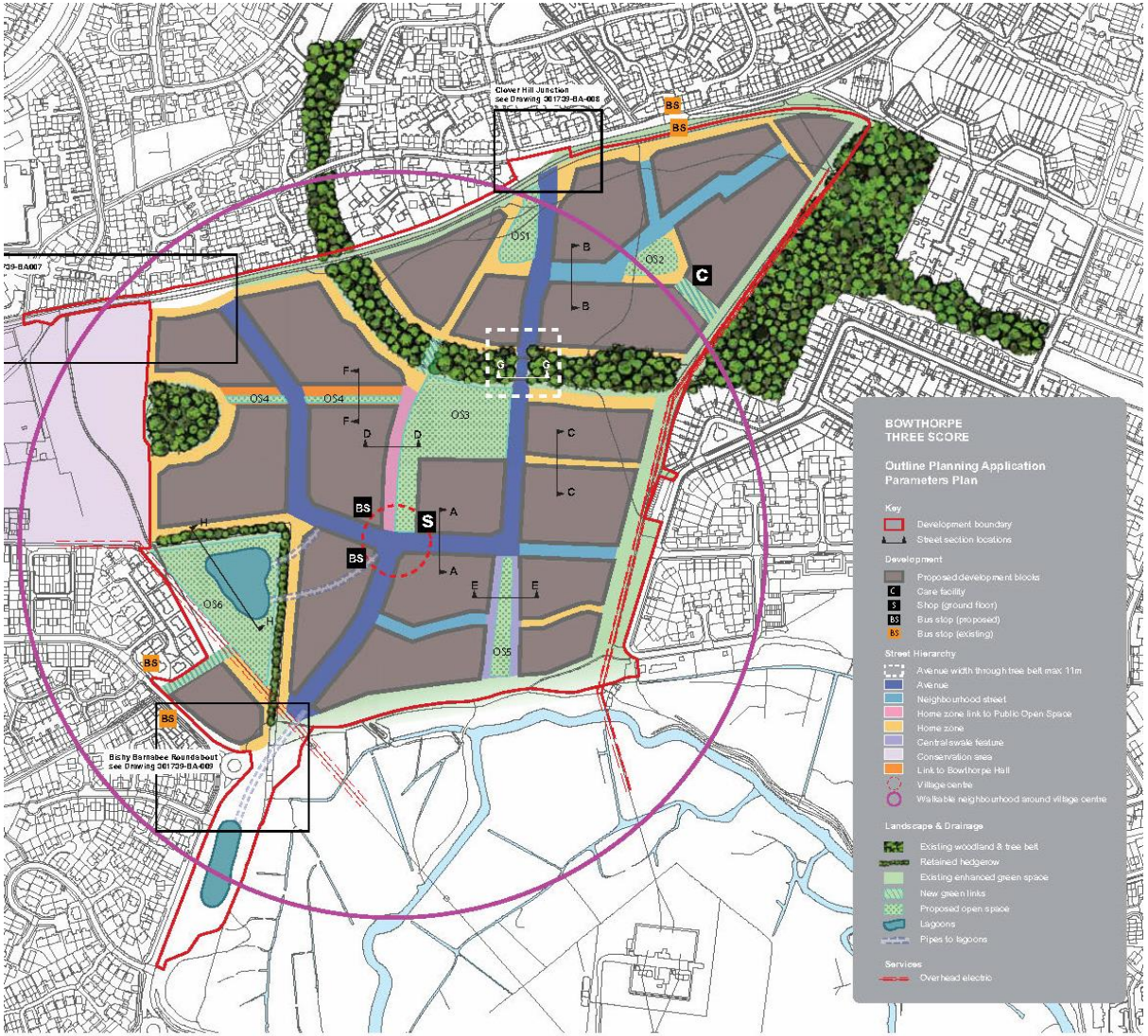
Bowthorpe Care Village

- 92 Housing with Care Flats
- 80 Dementia Care Apartments

PHASE 2

Bowthorpe Three Score

- 172 Houses



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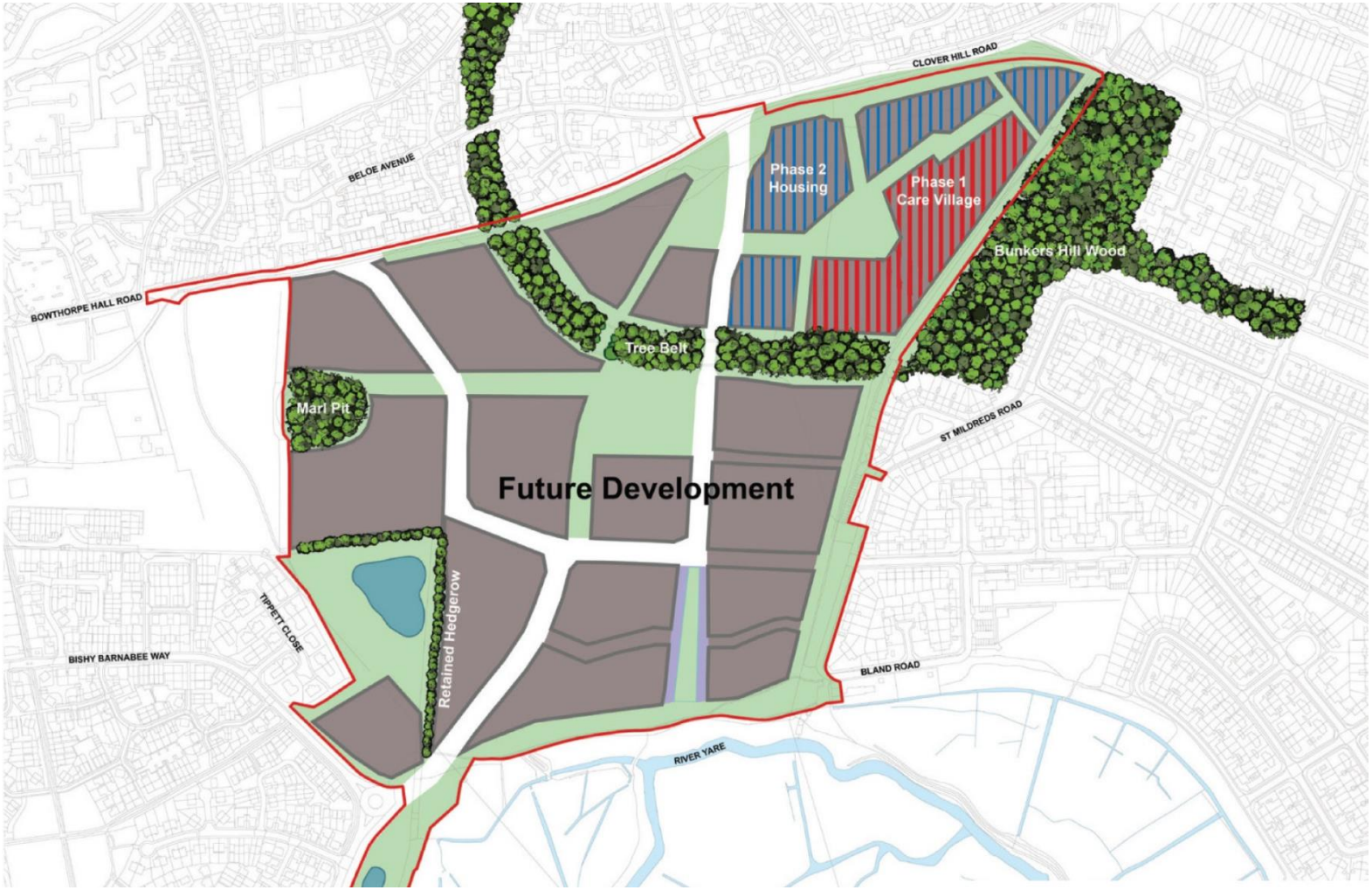
1.1 | Three Score Phase 1 & 2



2.0 | Client Vision

AIMS	To provide social and private housing desperately needed in the City.
VISION	To provide housing with contemporary design with traditional values, rejuvenating local communities.
SCOPE	Joint venture that incorporates design and project management coupled with strategic advice to deliver good quality homes.

Environmental Objective: Passivhaus

Social Objective: communal gardens

Financial Objective: Tenure Blind Exemplar Housing

But how do these principles work with Passivhaus…….

Three Score Phase 2 – Concept Principles

Extending the green corridors – linking Three Score with Bowthorpe Hall and existing Village Centre of Clover Hill and Earlham

Connecting Pedalways

Giving Bowthorpe a new identity – creating a gateway for the new Three Score masterplan and elevating design quality for the remaining masterplan to follow.

Home Zones and safer streets – prioritising pedestrian movement over cars.

Bowthorpe Care Village – providing a response to the Care Village (phase 1).

2.1 | Tenure Strategy

Tenure Blind principles:

- One space standard,
- Consistent building fabric and materials
- Consistent amenity space
- Internal finishes strategy

Allows flexibility for client if market changes

For example, client could increase shared equity rather than disposals

Design Considerations:

- Social /Market Housing
- Location of Passivhaus (orientation)

How does this work with Passivhaus?

2.2 | Three Score Masterplan

3.0 | Our Passivhaus Journey

	Milestones	HBS Projects	Internal Development (CPD)	Professional Advice
2012				
2013				- PHPP illustrated published for the RIBA (Sarah Lewis) - SME presentation on Passivhaus for Adapt (Sarah Lewis)
2014	- 10% of Hamson Barron Smith staff trained as PH Certified Designers			- HBS present at International Passivhaus conference
2015	- 20% of staff trained as PH Certified Designers - 50% of Staff THERM (thermal bridge assessment software) trained	Carrowbreck Meadows (14 Units) Hansard Close (10 Units) Three Score Phase 2 (112 Units)	- Develop a monitoring procedure for completed Passivhaus schemes.	- Passivhaus Presentation to Norwich University of the Arts Students
2016	- Delivering Passivhaus through different procurement routes (Traditional & Design & Build) - Post occupancy monitoring to min. 20% of Passivhaus developments. - Carrowbreck complete. Ready for 2016 Passivhaus Open days 11-13 Nov		- Research AECB Silver standard spec on Three Score for non-Passivhaus dwellings	- HBS Attendance at AECB Conference 2016 in Norwich. - AECB tour of Carrowbreck Meadows
2017	- Review and increase post occupancy evaluation		- Analyse Carowbreck post occupancy performance	- Present findings on post occupancy evaluation
2018	- Review and increase post occupancy evaluation			- Present findings on post occupancy evaluation
2019				
2020				

3.1 | Scope of Passivhaus Service

1.1 RIBA Stage 0

- Advising on the suitability of the site, cost and strategy. This work fed into the Pro-Dev produced by the Housing Development Team

1.2 RIBA Stage 1-2

- Initial introduction of Passivhaus principles to client.
- Initial Passivhaus review of the site and analysis based on mass and orientation. This work was presented as part of the first public consultation.
- Passivhaus Planning Package (PHPP) modelling based on the completed Stage 2 drawing pack, taking into account the developing Stage 3 designs.
- Initial Mechanical and Electrical Design Advice .
- Input into the planning process.

1.3 RIBA Stage 3

- Refined PHPP models to further assess the foundations, structure, window proportions, MVHR, and shading strategies.
- A range of construction methods explored with the final construction method to be developed with the Constructor during the two stage tender process.
- Airtightness Strategy and Developed Design

Hamson Barron Smith

Passivhaus consultant fees - Three Score Phase 2

	RIBA Stages	Tasks	Outputs	Days	Day Rate	Cost
0	Strategic definition	Advising on suitability of site, costs, strategy	Report on options	4		
1	Preparation and Brief	Procurement advice on ERs and contracts. Workshops on what is Passivhaus. Cost and supply chain advice.	Report on procurement; overview of site and suggested supply chain considerations; attendance at design team meetings; attendance at client meetings	4		
2	Concept Design	Liaising with lead architect. Develop the building design through the use of the Passivhaus Planning Package (PHPP). Each design option / iteration will need to be tested in PHPP to ensure that the project is likely to achieve the standard.	fortnightly/monthly report on recommendations, PDF of PHPP; attendance at design team meetings; attendance at client meetings	15		
		Mechanical & Electrical design advice, ensuring efficient & economical layout of building services in order to increase operational efficiency.	report on recommendations; liaising with M&E team	2		
		Contribute to Planning papers and consultation	report on Passivhaus	5		
3	Developed Design	Passivhaus Planning Package (PHPP) modelling and feedback, attendance at 5 design team meetings; supply chain analysis (foundations, structure, windows, MVHR, form, orientation, shading, airtightness);	fortnightly/monthly report on recommendations, PDF of PHPP; attendance at design team meetings; attendance at client meetings; set up of supply chain workshops with clients	15		
		Develop a preferred construction method and typical wall, floor and roof constructions.	report outlining options	10		
		Liaising with lead architect, develop a rigorous and achievable insulation and air tightness strategy and discuss specific detailed design issues with the structural engineer	report outlining options	5		
		coordination with Code/SAP assessors and renewable energy consultant	recommendations on code and SAP	2		
4	Technical Design	Design iteration as above, but also		15		
		Thermal modelling of complex details in order to prevent heat loss & condensation	report on recommendations; liaising with design team	10		
		Specification of efficient fixtures and fittings to reduce the electrical consumption of the building & thus reduce Primary Energy consumption.	report on recommendations; liaising with maintenance team and tenants	5		
		Contribution to Building Reg documentation liaising with Structural Engineer, Fire and Building Control.	Report to various parties.	5		
		Mechanical & Electrical design advice, ensuring efficient & economical layout of building services in order to increase operational efficiency.	report on recommendations; liaising with M&E team	2		
			Sub total for design			0
5	Construction	"Toolbox" talks enabling foreman to understand and achieve complex details across the whole building. Training of air tightness champion.	workshops, preparation of workshops; hand outs; Q&A	20		
		clerk of works	site visits fortnightly reports; recommendations; attendance at client meetings; attendance at contractor meetings	30		
		Technical Support	liaising with contractor on issues that clerk of works has picked up. Re-iteration of PHPP	10		
		Ventilation commissioning	liaising with sub-contractor and contractor to ensure effective installation	10		
		Air testing commissioning	2 required during construction and one at completion.	10		
		Liaising with certifiers	preparation of paperwork and reports	10		
6	Handover and Close Out following the Soft Landings Guidance	Soft Landings means designers and constructors staying involved with buildings beyond practical completion. This will assist the client during the first months of operation and beyond, to help fine-tune and de-bug the systems, and ensure the occupiers understand how to control and best use their buildings. (https://www.bsria.co.uk/services/design/soft-landings/)				
	Soft Landing Framework 3& 4	workshops with tenants on living in a Passivhaus	workshops, preparation of workshops; hand-outs; Q&A	10		
		workshops with maintenance team	workshops, preparation of workshops; hand-outs; Q&A	5		
		leaflets, hand-outs, posters	design of leaflets liaising with maintenance team	10		
7	In Use following Soft Landings Guidance. Framework 4&5	Soft Landings approach. Remote or site based commissioning advice to ensure all systems are running as expected.	Using Soft landings approach to ensure buildings are optimised. Monthly site visits. Monthly Reports and liaising with client, contractor, M&E and end users.	20		
	Framework 4&5	Building environment monitoring (CO2/heat/humidity) to enable optimisation of the internal environment. ***Cost of equipment is a separate price.***	Using Soft landings approach to ensure buildings are optimised. Monthly Reports analysing end user behaviour liaising with client, contractor, M&E and end users	10		
		Build Certification (undertaken by third party subject to third party quotes)	*per unit*	**294**		0

assumptions:

This is an indicative proposal based on known information. It may be that one or two of the tasks will require a time charge rather than a fixed fee. This will be negotiated with the client.

number of houses	154
Number of house types	5

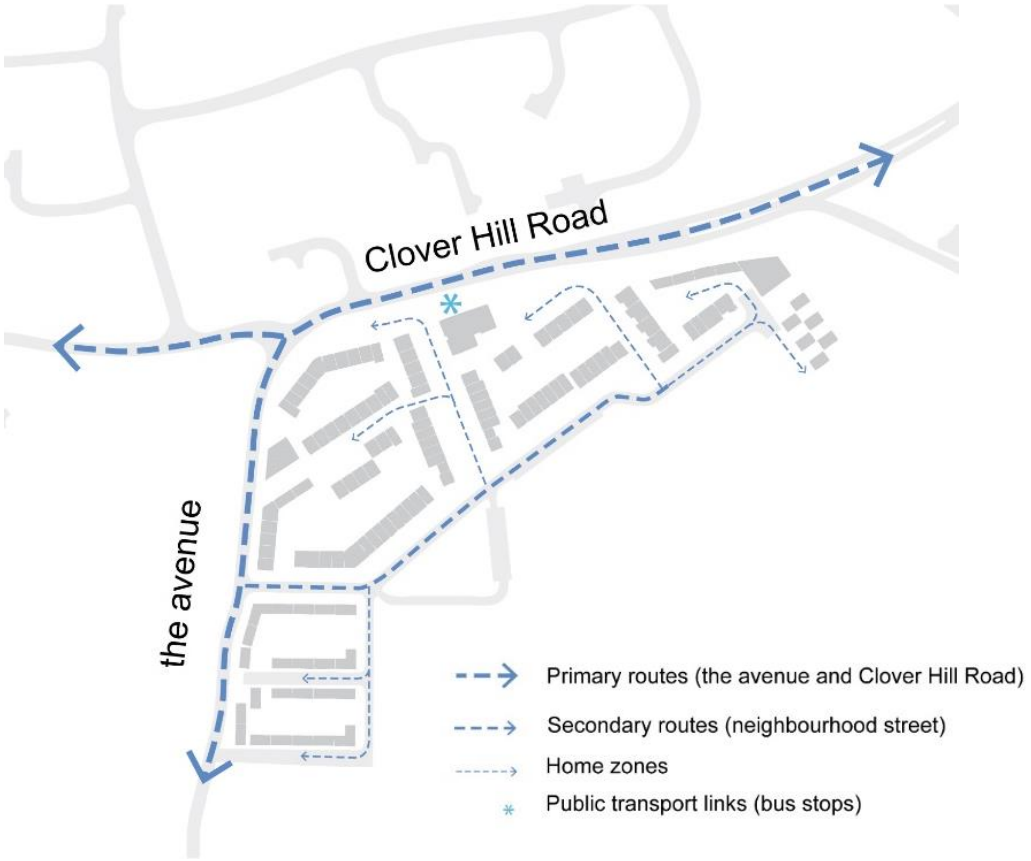
sub total construction and handover fees exc third party certification	0
sub total construction and handover fees inc third party certification	0
TOTAL FEES EXC third party certification	0
TOTAL FEES INC third party certification	0

4.0 | RIBA Stage 1 – Access & Movement

Homes will be accessed from the new avenue which runs along the western boundary of the site, connecting to Clover Hill Road (north) and Bishy Barnabee Way (south).

There are three types of street proposed.

- 1. Clover Hill Road and the new avenue are primary routes.
- 2. Running east / west is the secondary neighbourhood street which then leads into home zones and Bowthorpe Care Village.
- 3. Home Zones are proposed throughout the development, giving priority to pedestrians and cyclists.



4.1 | RIBA Stage 1 – Green Links

Two green links are identified within the site.

The **Greenway** will run north / south through the centre of the site to link the existing village centre of Clover Hill with the gateway to the Three Score masterplan.

Along its length will lay a **variety of landscape spaces, pocket parks** and features.

The east / west link will connect the proposed open space at the entrance to the masterplan, with the green pocket parks and wildflower meadows proposed along Clover Hill road.

Proposed green link

Existing landscape features

Proposed green link features

Proposed semi-private community gardens

4.2 | Local Vernacular

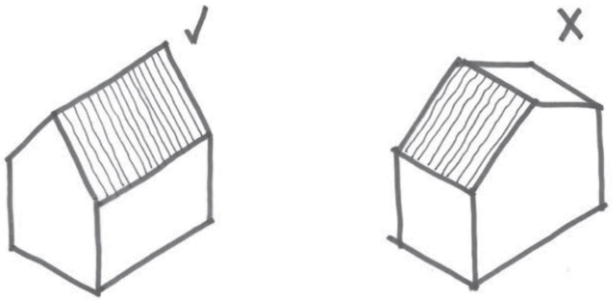
Norfolk Barn style

The decision to reference historically successful housing types is a deliberate one, born out of an appreciation of the local vernacular so that it acts as a compliment to the local fabric rather than an overtly assertive object.

The response is a contemporary rendition of a well established and local typology, a ‘Norfolk style’, conveying a sense of familiarity and appropriateness.

The Norfolk style is defined by a number of references to the historic barn vernacular seen through Norfolk. With roof orientation defined in a logical structural way, the roof should span across the narrowest plan dimension.

Carrowbreck Meadows (14no Passivhaus dwellings)



4.3 | RIBA Stage 1 - Initial Passivhaus Assessment

Orientation

- Determines the availability of free passive solar heat for the building.
- The orientation also influences the risk of overheating.
- Where possible blocks were laid out so that the long facades were within 30degrees of south.

4.4 | RIBA Stage 1 - Initial Passivhaus Assessment

Form Factor

- Prioritised simple building forms
- Terraces
- Large flat blocks
- Where detached properties are required, prioritise the larger 4/5 bed properties.

4.5 | RIBA Stage 1 - Initial Passivhaus Assessment

Overall Stage 1 Strategy

combined plan considering both the orientation and form factor of the blocks.

The plan highlights the 80 homes which are optimised for Passivhaus certification

NEXT STEPS

- *Are there any efficiencies that can be introduced?*
- *Can we review the orientation*
- *Can we simplify the form*
- *Do we need to improve/ vary our fabric performance?*

5.0 | RIBA Stage 2 – Passivhaus Workflow

For the stage 2 assessment the PHPP models assumed the following fabric performance:

Element	Housing	Flats	Building Regulations
Walls	0.09 W/(m²K)	0.114 W/(m²K)	0.18 W/(m²K)
Floors	0.09 W/(m²K)	0.108 W/(m²K),	0.13 W/(m²K)
Roof	0.114 W/(m²K)	0.114 W/(m²K)	0.13 W/(m²K)
Windows (Frame)	0.75 W/(m²K)	0.75 W/(m²K)	1.4 W/(m²K) whole window G value = 0.63
Windows (Glass)	0.57 W/(m²K)	0.57 W/(m²K)	
MVHR	84% (average of all certified units)		
Airtightness	0.6ACH @50Pa		5

In addition to these fabric assumptions the following operational assumptions were made:
Occupancy would be at 80% of bed spaces
Ventilation rates would be 0.4ACH to comply with Part F
Minimal night time (purge) ventilation is assumed: 0.1ACH
In the larger homes some day ventilation is assumed: 0.1ACH

6.0 | RIBA Stage 3 – PHPP Assessment

This table summarises the key results for each block as modelled in PHPP. The flats are highlighted in yellow.

The final two columns are the important results, showing the final Heat Demand (HD) and the final Heat Load (HL). At this stage we are looking for blocks to be achieving a max. of 13.5kWh/(m^2a) HD or a max of 9 W/m^2 HL.

At Stage 2 this equated to 123 units. The yellow stars highlight those very close to these requirements (18 units), these blocks could be developed to meet the standards.

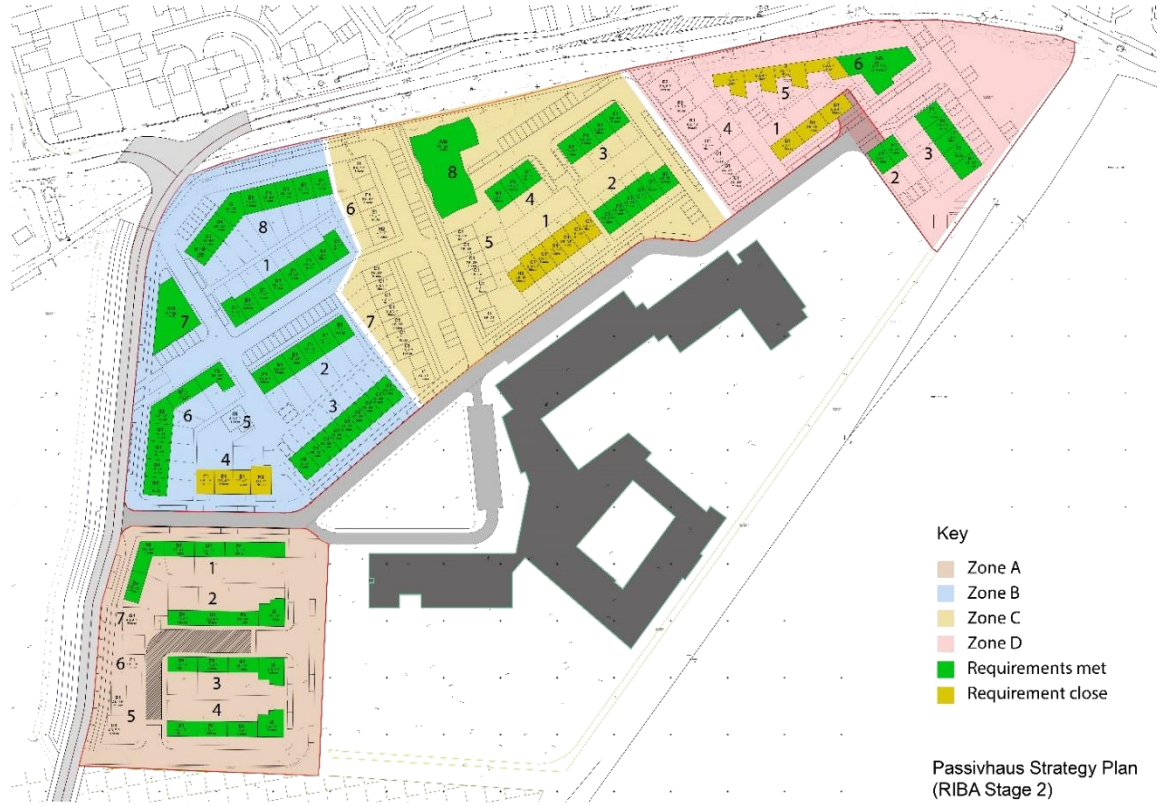
Group	Block	Total no. of units	Occupancy @ 80%	Minimum Occupancy PHPP	Form factor	FINAL HD	FINAL HL	
A	1	6	19.2	15.9	3.01	13.5	9.5	★
A	2	4	15.2	10.7	2.58	13.1	8.8	★
A	3	4	15.2	10.7	2.58	11.5	8.5	★
A	4	4	15.2	10.7	2.58	9.2	8.3	★
A	5	2	8.8	5.7	3.27	17.7	10.3	
A	6	1	3.2	2.2	4.09	21.1	11.3	
A	7	1	**4.8**	3.1	3.63	16.5	10.2	
B	1	9	25.6	17.7	2.67	15.4	9.0	★
B	2	6	19.2	13.6	2.68	12.0	8.6	★
B	3	9	24.8	19.2	2.42	15.2	8.9	★
B	4	4	**15.2**	10.0	3.01	15.9	9.4	★
B	5	1	**4.8**	3.1	3.63	17.6	10.5	
B	6	7	**22.4**	21	2.67	13.4	8.6	★
B	7	12	**25.6**	21.4	1.92	9.7	8.2	★
B	8	11	**37.6**	33.9	2.37	9.7	7.8	★
C	1	7	24.0	15.4	2.54	15.7	8.8	★
C	2	6	20.8	13.4	2.59	14.6	8.7	★
C	3	4	12.8	9.1	2.81	12.4	8.7	★
C	4	3	9.6	6.8	2.95	12.6	8.8	★
C	5	7	26.4	16.5	2.76	16.3	9.5	
C	6	4	17.6	10.8	3.04	15.9	9.9	
C	7	8	28.0	17.4	2.74	17.4	9.7	
C	8	22	37.6	33.3	1.78	7.1	6.3	★
D	1	3	**9.6**	7.5	3.23	13.9	10.0	★
D	2	2	**9.6**	5.7	1.64	12.6	8.8	★
D	3	5	24.0	14.2	2.32	12.9	9.0	★
D	4	7	30.4	17.7	3.35	17.6	10.4	
D	5	4	14.4	9.6	4.19	15.6	10.9	
D	6	12	22.4	19.5	2.08	10.6	8.6	★

6.1 | RIBA Stage 3 – Passivhaus Site Assessment

The plan below shows the blocks which have been calculated to be the most suitable for Passivhaus certification. These are largely in line with the initial Stage 2 PHPP site analysis of orientation and form.

- 123 units currently meeting the targets
- a further 18 very close to the target
- giving a total of 141 units which at this stage could be taken forward for certification.

The next step would be to introduce a **shading strategy** which could target the blocks most at risk of overheating.



Passivhaus Strategy Plan
(RIBA Stage 2)

6.2 | Proposed Site Plan

1 + 2 Bed flats
5 Bed house
4 Bed house
3 Bed house
2 Bed house

6.3 | Solar Shading

Quality homes of the past have always made use of elements to provide details which are rooted in place and history.

Our proposals for Three Score Phase 2 are to provide this connection with Norwich and Bowthorpe, not only through the building forms and materials used but through the use of pattern and decoration.

To achieve this, references to the historic textile industry are integrated into the elevation designs throughout the proposals. It is proposed that a selection of historical textile designs are converted onto laser cut metal balcony and feature infill panels.

Norwich heritage textile pattern in laser cut metal balcony and shading detail

Typical home frontage

Norwich Drawloom Shawl (1840) an important shawl for Norwich as it is one of the very few which can be safely attributed to Willett & Nephew, one of the largest and most influential shawl manufacturers in the city.

Example street scene

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6.5 | Ventilation Strategy

Following stakeholder feedback the key considerations where:

- Easy access for maintenance.
- Private units could have external or internal MVHR units—both options to be explored.
- Can we provide flexibility within house types to accommodate MVHR either internally or externally?

How does this impact tenure blind approach?

6.6 | Stage 3 - Ventilation Strategy

Design Solution

- **Private Flat blocks** to have individual MVHR units—these may be located above dropped ceilings, likely to be in bathrooms. Ease of access to be considered

- Affordable Flat block may have a combined MVHR system to remove individual maintenance burden — plant room approach to be considered, duct routes to be established.

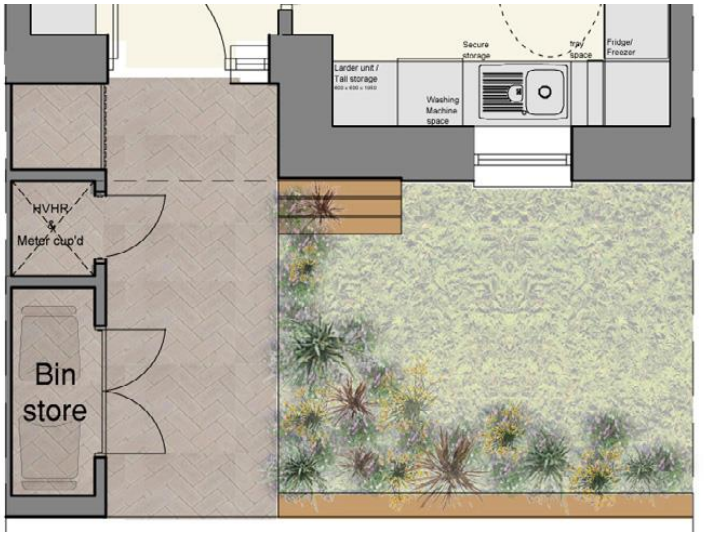
- Dwellings to have external store for MVHR by front doors. Additional area added to internal stores to ensure flexibility on plan.

MVHR unit located close to the external wall of the house to minimise heat loss.
Space provided for duct runs
Opportunity to conceal meters

Opportunity to integrate a folding bench and access panel to the MVHR unit for easy filter changes.

When closed MVHR unit is not visible

6.7 | RIBA Stage 3 - Ventilation Strategy



6.8 | Passivhaus – Stage 3 Proposal

- 112 of the 172 units are to be Passivhaus Certified
- Includes, Social Rent, Market Sale and Private Rent units. (tenure blind)

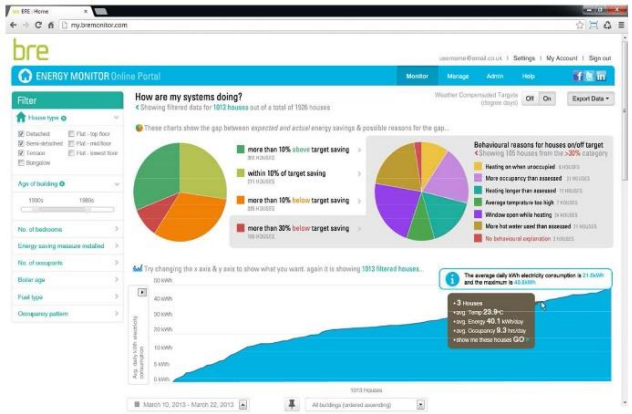
7.0 | Monitoring Proposals

Design Solution

- web based monitoring system (BRE Hub)
- completely modular so residents can add or remove technology to suit them.

Monitoring:

- External Temperature Sensor
- Room Temperature & Humidity sensor
- CO2 Sensor
- Heat meter with temperature probes
- Zigbee pulse counter to count external meter pulses (Energy use).

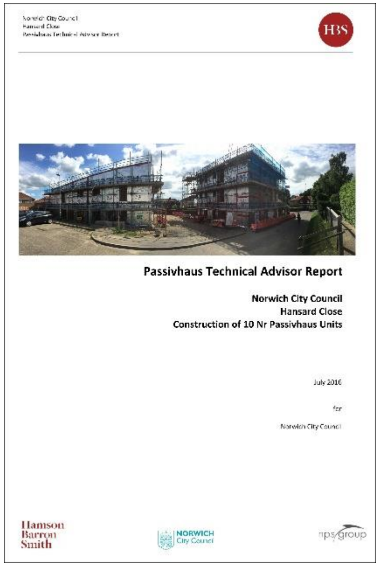


BRE House Monitoring Price List

Product	Description	Quantity	Price GBP
T3521	BRE Energy Monitor 'Hub' with WiFi and energy monitoring software.	1	415.00
NET-WT-3G1	BRE Energy Monitor 'Hub' with WiFi and energy monitoring software and 3G capability	1	130.00
3G-24	3G SIM card and connection contract (mobile phone provider to be decided when the order is placed for this part)	Price TBA Per Order	TBA
BRE-UPLOAD	BRE Data Upload Software Tool to allow sensor raw data transactions to be uploaded into the Cloud Server	1-off fee	150.00
BRE-AAP	BRE Data Analysis Application Software Tool that provides hosting to the Cloud Server and a software license to access and analyse data. Charged as a monthly fee. Includes BRE software support	Per Unit	15.00 pcm
T3522	Internal temperature sensor	1	76.00
T3524	Occupancy Sensor	1	45.00
T3528	External Temperature Sensor	1	90.00
T3527	Boiler Flow and return and sensor probes Hot Water tank and sensor probes	1	96.00
T3542	Room temperature and humidity sensor	1	50.00
T3571	CO2 Sensor	1	180.00
T3519	Generic (Electricity & Gas) pulse counter	1	75.00
T3519-RJ11	Gas meter pulse counter, includes T3519 pulse counter and pre-wired T7320CAB (RJ11 cable, eg for Schlumberger meters)	1	104.00
T3519-ITRN	T3519-ITRN - Gas meter pulse counter,comprises T3519 pulse counter and pre-wired T7320CAB and T7320-IT (an ITRON cable and sensor attached)	1	110.00

* requires 3G SIM card and phone provider's contract

8.0 | Post Contract Strategy



Norwich City Council
Hansard Close
Passivhaus Technical Advisor Report

Passivhaus Technical Advisor Report

Norwich City Council
Hansard Close
Construction of 10 Nr Passivhaus Units

July 2016

for

Norwich City Council

Norwich City Council
Hansard Close
Passivhaus Technical Advisor Report

2.3 Superstructure

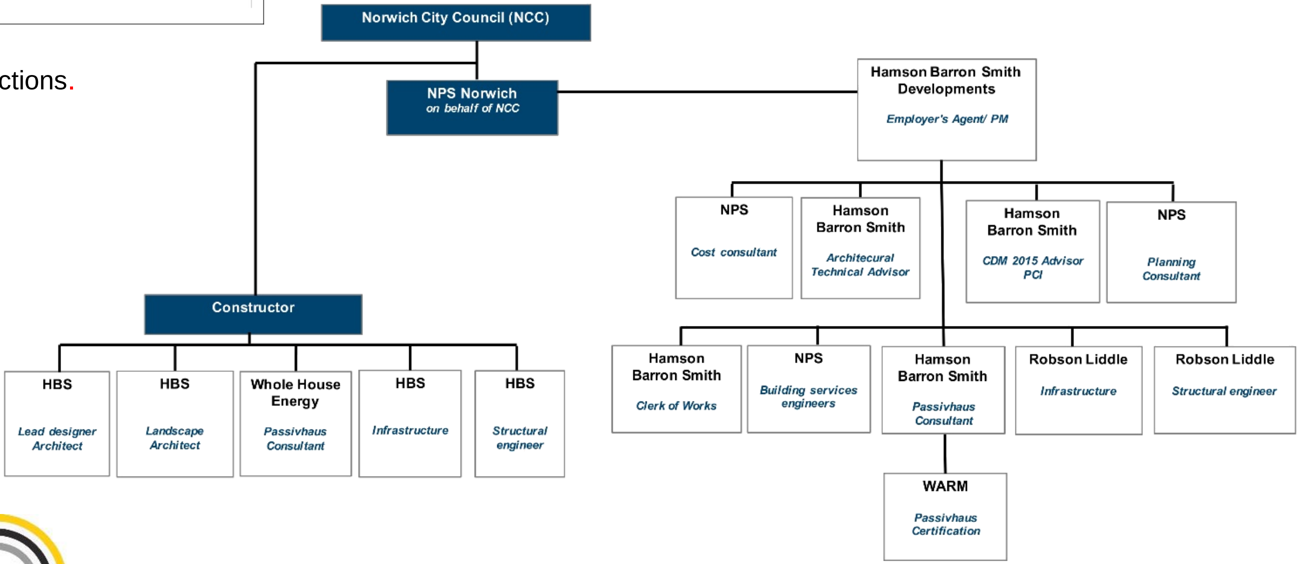
The Cygnum timber frame has now complete. Warmcell has been installed in Block B and Block A is being completed this week.

2.3.1 Water ingress has been noted in flat 8 during our visit on 19th July, at the point where the underside of the terrace meets the party wall. Water was apparent between the OSB and Intello Plus membrane. Cygnum and ENS agreed to cut the membrane to review the problem. Following review it was confirmed that water ingress was occurring due to the party wall parapet on the terrace being left unprotected during a recent downfall. The party wall is now protected and Flat 8 appears to have dried out. It is being left for a period of time so that is can be monitored before being taped again. ENS to continue monitoring and review with HBS and Andrew Fisher before works are closed up.

2.3.2 During our site visit 25th July it was noted that water ingress was also apparent on Flat 7, consistent with that seen previously on Flat 8. ENS and Cygnum to assess this further and report back on findings before any further works are closed up.

Project documentation and site quality inspections.

Investment in training. (RG Carter Construction)



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9.0 | Passivhaus Challenges

- **Planning policy geared to 10% renewables not “fabric first” approach**

The approach to energy use has been to adopt a fabric first methodology with an emphasis on **energy efficiency** rather than **energy generation**.

The Planning Policy Statement: Planning and Climate Change December 2007 Supplement to Planning Policy Statement 1 states:

“Renewable and low-carbon energy includes energy for heating and cooling as well as generating electricity.”

The energy generation strategy is to achieve 10% through the installation of mechanical ventilation and heat
recovery (MVHR) rather than Photovoltaics. The Local authority agreed that MVHR can be classed as a Low Carbon Technology and was therefore an admissible technology.

- **Scepticism by housing management – how will our tenants cope? Concerns over maintenance regimes etc. Components more expensive to replace/ maintain.**

10.0 | PHPP Comparisons

Element	Houses (Stage 2)	Flats (Stage 2)	Houses (Stage 4)	Flats (Stage 4)
Walls	0.09 W/(m²K)	0.114 W/(m²K)	0.09 W/(m²K)	0.125 W/(m²K)
Floors	0.09 W/(m²K)	0.108 W/(m²K),	0.083 W/(m²K)	0.083 W/(m²K)
Roof	0.114 W/(m²K)	0.114 W/(m²K)	0.100 W/(m²K)	0.100 W/(m²K)
Windows (Frame)	0.75 W/(m²K)	0.75 W/(m²K)	0.78 W/(m²K)	0.78 W/(m²K)
MVHR	84% (average of all certified units)		84% & 92% dependant upon House/ Flat.	
Airtightness	0.6ACH @50Pa		0.6ACH @50Pa – Contractor target is 0.45	
Primary Energy			80-100kWh/m2/a	80-110kWh/m2/a

11.0 | Passivhaus Implications

- Tackling fuel poverty - a key client consideration, especially when building at scale.
- Tenure Blind
- Quieter internal environment
- No cold surfaces or draughts
- Better indoor air quality
- Better end-user consultation and feedback.
- Bridging the performance gap.

Lessons Learned

- Plan out the project team early, and engage with M&E to identify strategies.
- Consider form and orientation at the earliest outset, agree a strategy and then refine it.
- One size doesn't fit all. The design (and technical solution) has to respond to the site.
- Consider Passivhaus implications when designing massing and fenestration. Design for daylight but consider shading requirements.
- Engage with stakeholders at the earliest opportunity to demystify Passivhaus.
- Prioritise transparency in the design team, share problems and solutions.
- Airtightness champion - the right person, involved in the right aspects of the job on site.
- Allow additional time for your presence on site, to document construction works.
- No blame culture.