

Session 2

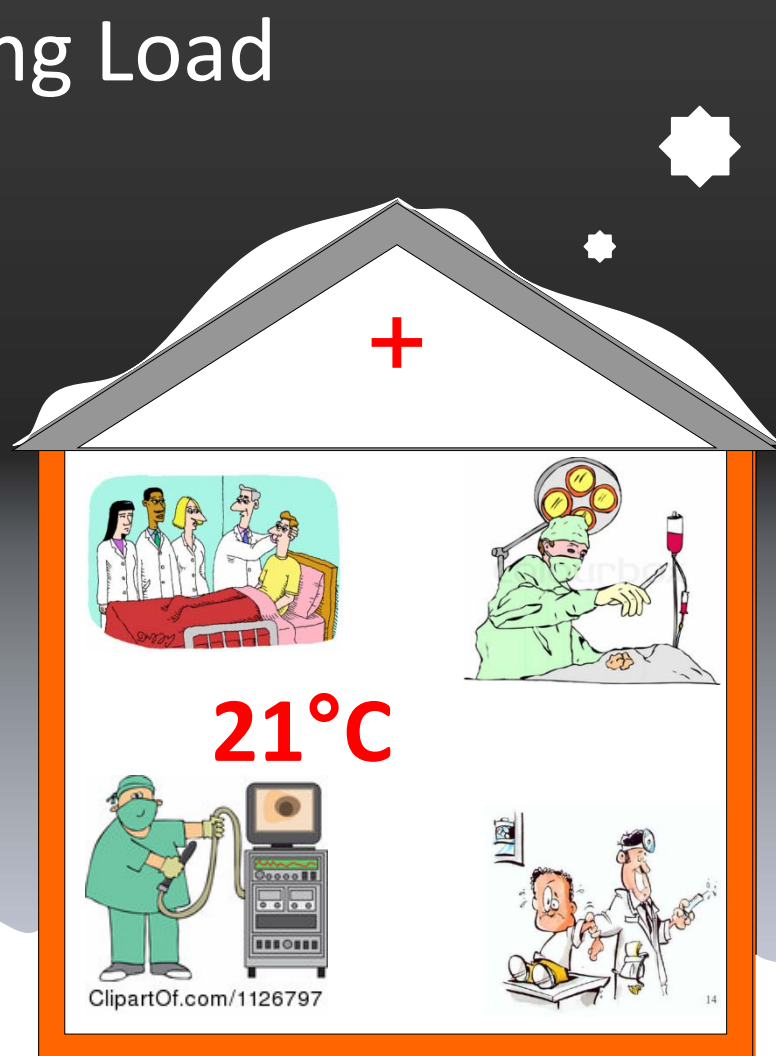
- Design information for closed loop systems
- Driller instructions and specifications
- What can go wrong

Design Info for Closed Loop Systems

What is a Building Load

Put simply...It's the energy needed to keep the internal temperature at a set point when considering everything that happens in the building and what is going on outside and what the building is made of

all winter the heat is trying to get out and in the summer it's trying to get in by the outside temperature. Add this up for each hour of each day and you arrive at the annual load

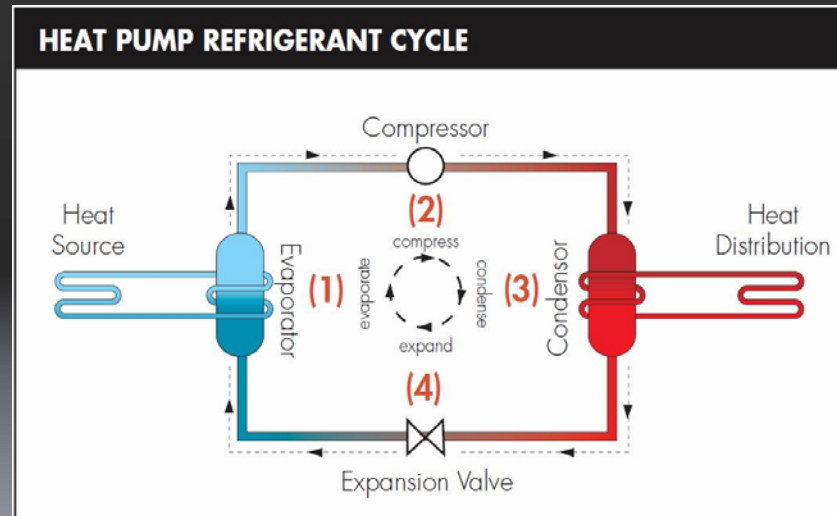


35°C !!

Design Info for Closed Loop Systems

What is a Ground Load

The “Ground Load” takes into consideration the compressor within the heat pump



Total Heat Absorption is energy from the ground (3 kW) + Energy from the compressor (1 kW) going into the building (4 kW) = COP 4

Total Heat Rejection is energy from the building (4 kW) + Energy from the compressor (1 kW) going into the ground (5 kW) = COP 5

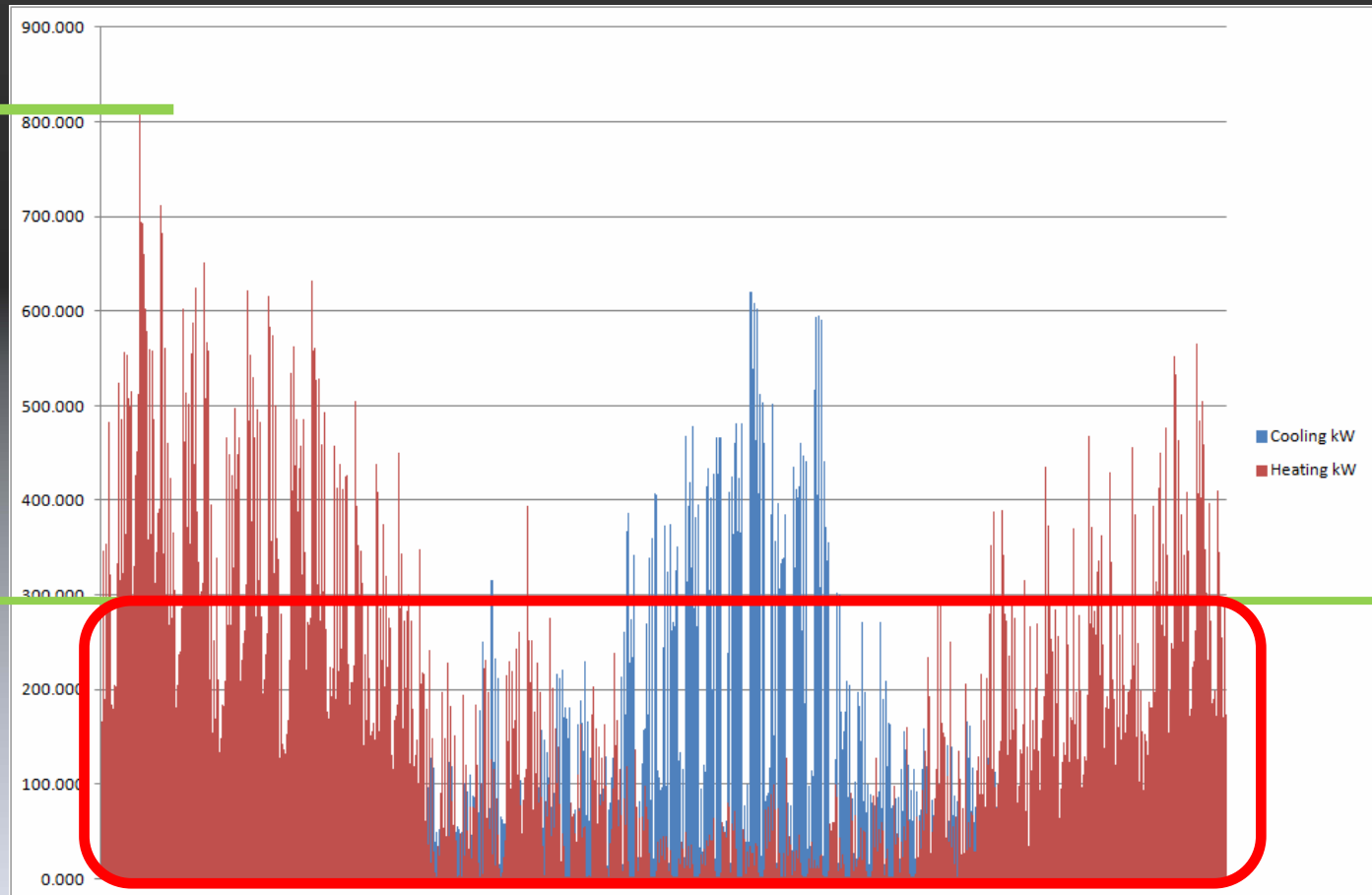
Design Info for Closed Loop Systems

What is a Base Load

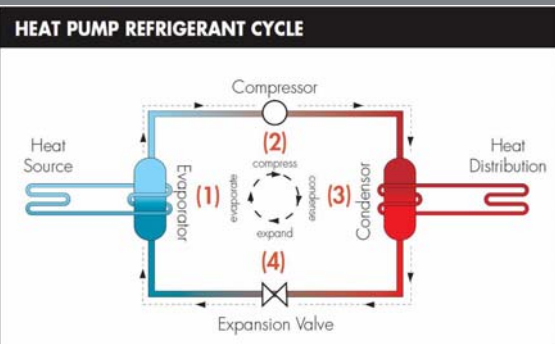
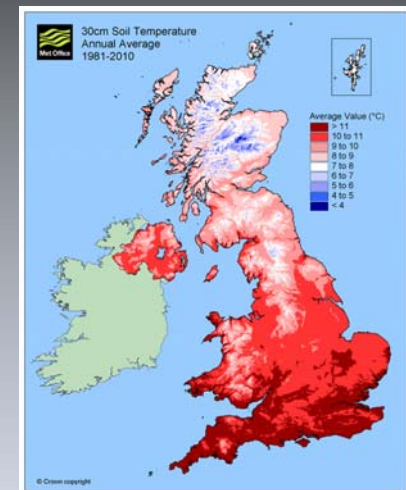
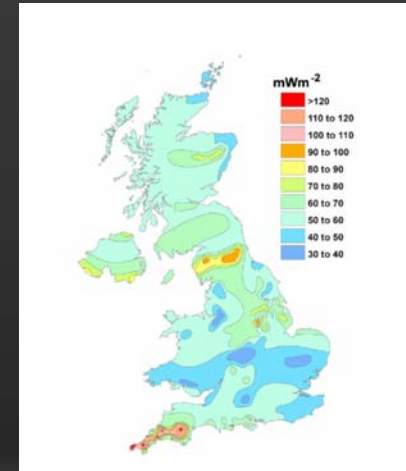
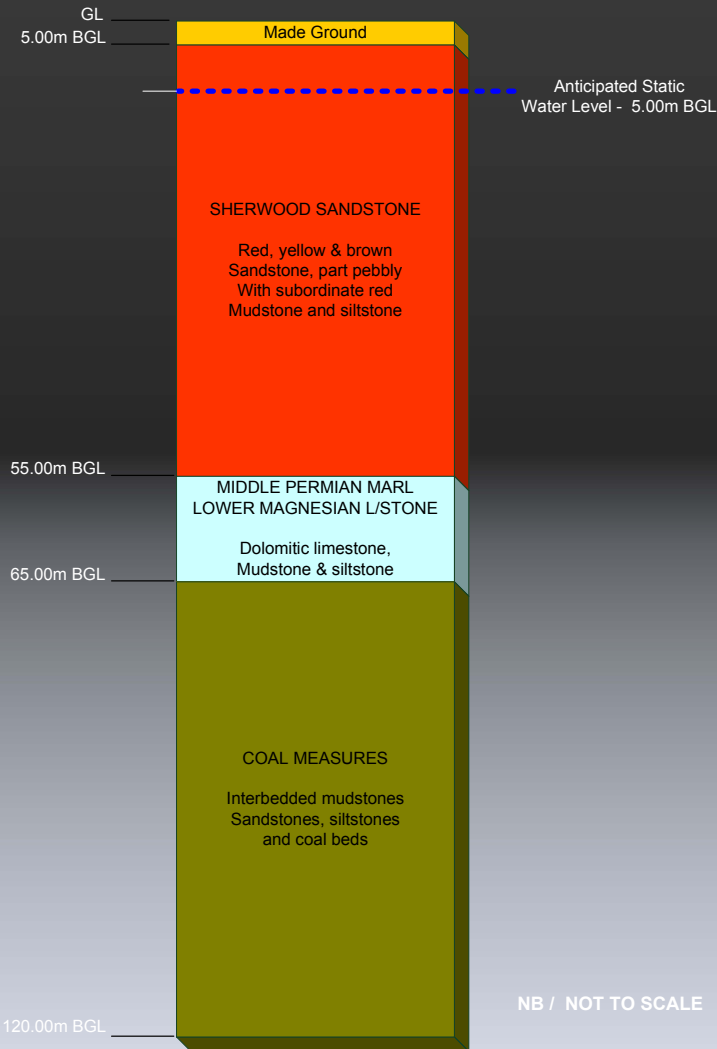
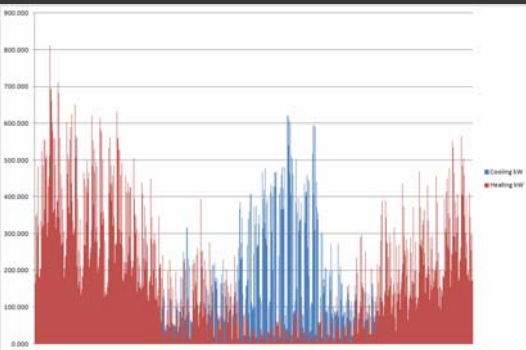
Peak Load
over 800 kW

Base Load of
just 300 kW

This still delivers
over 90% of the
annual heating
and cooling kWh



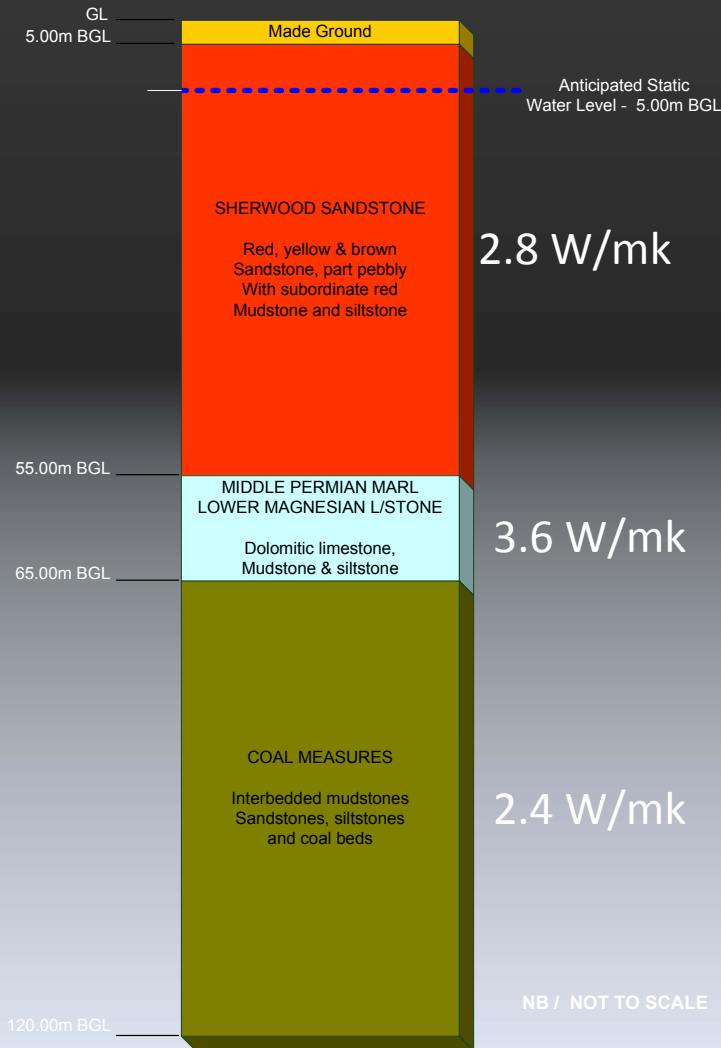
Design Info for Closed Loop Systems



NB / NOT TO SCALE

Design Info for Closed Loop Systems

Our Geology



1. Thermal Conductivity

2. Average Undisturbed Temperature

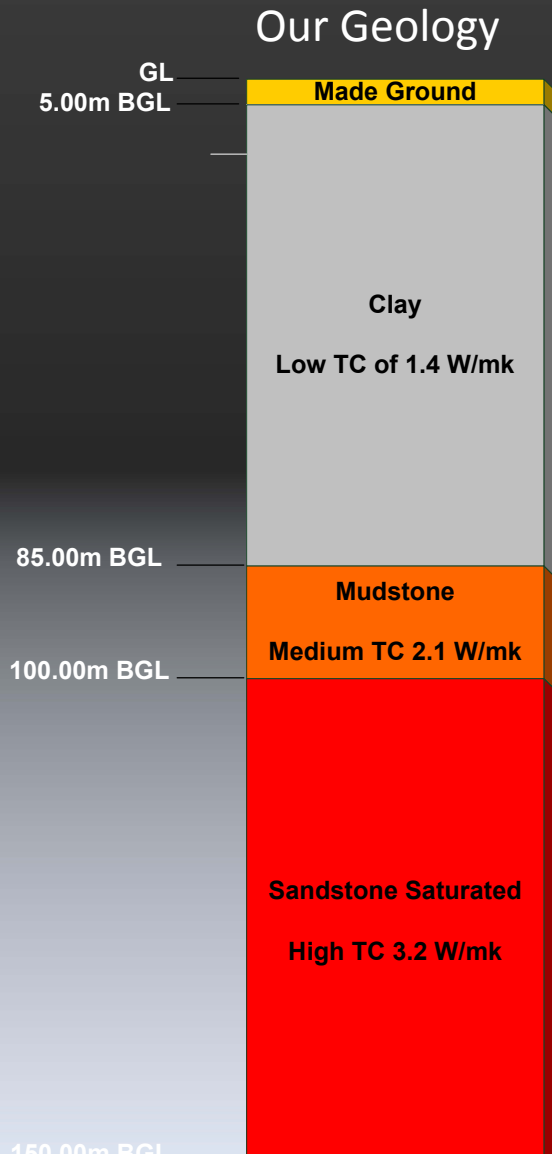
3. Volumetric Heat Capacity

4. Diffusivity

Accurate drill logs are vital to understand strata thickness and details of the geology and water levels

They will be read and used by the designer.
They are not just filed.

Design Info for Closed Loop Systems



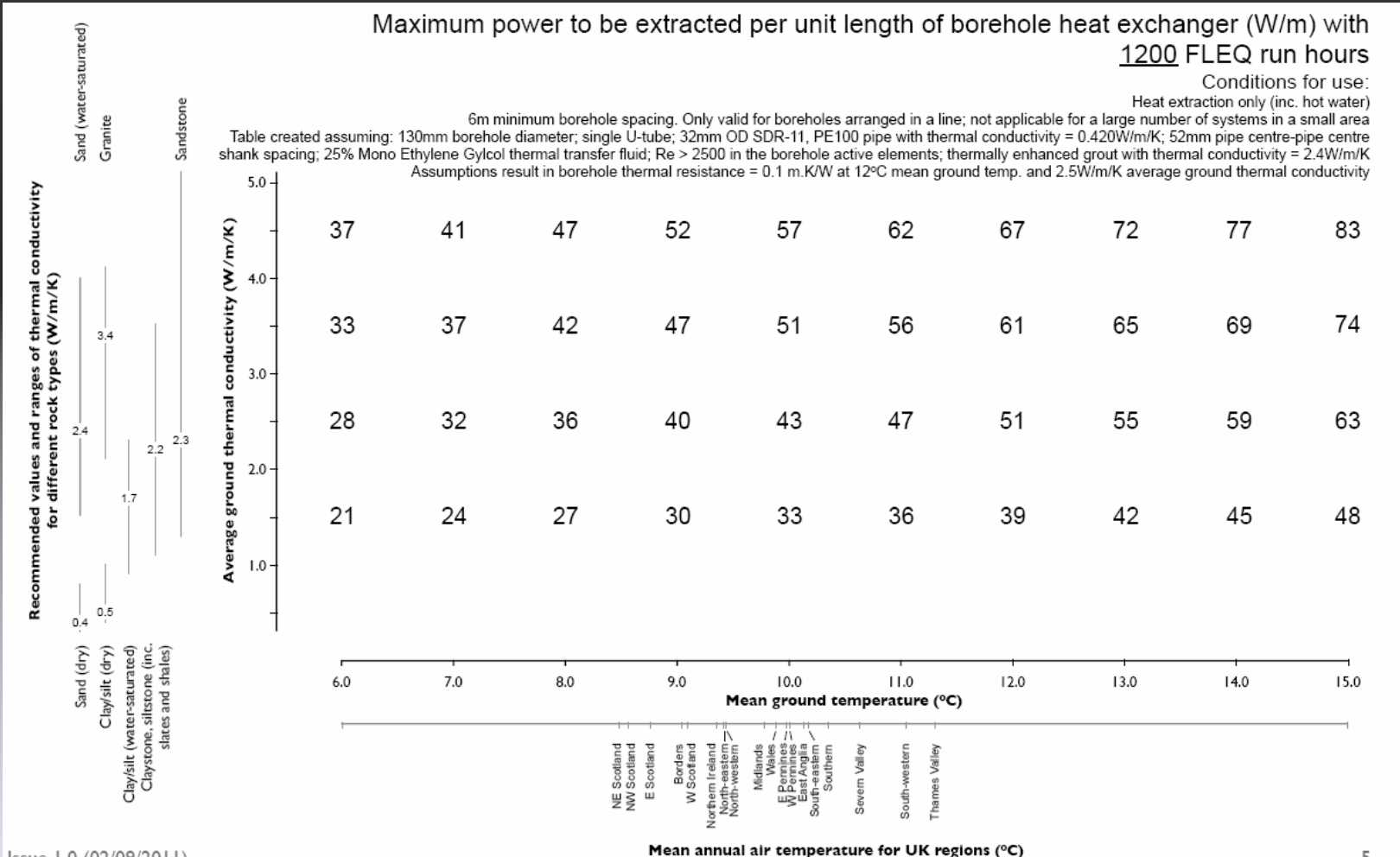
The outline design must be done before a test hole is drilled. The outline design decides what is needed for a test hole !!

Test Hole installed to 100 m gives Thermal Conductivity of 1.52 for the entire borehole

Test Hole installed to 150 m gives Thermal Conductivity of 2.07 for the entire borehole

Design Info for Closed Loop Systems

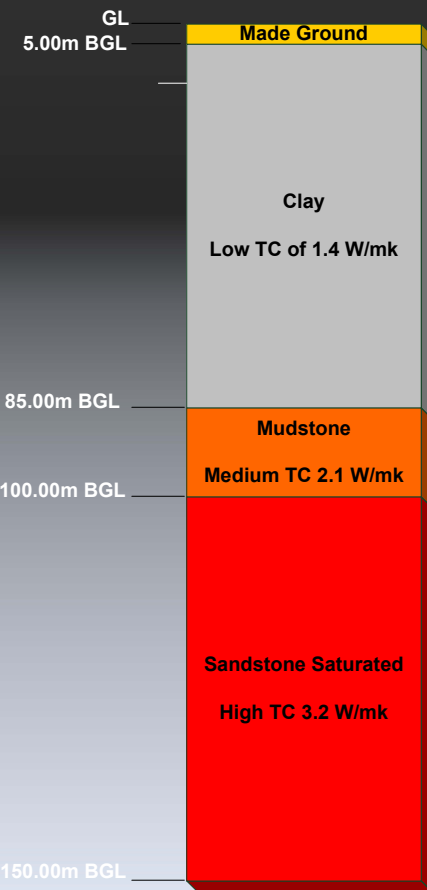
MIS 3005 Look Up Tables



Design Info for Closed Loop Systems

Thermal Response Testing (TRT)

Accurate Drill Log?



Samples



Hole Drilled with Air in Summer?



Hole Fully Grouted?

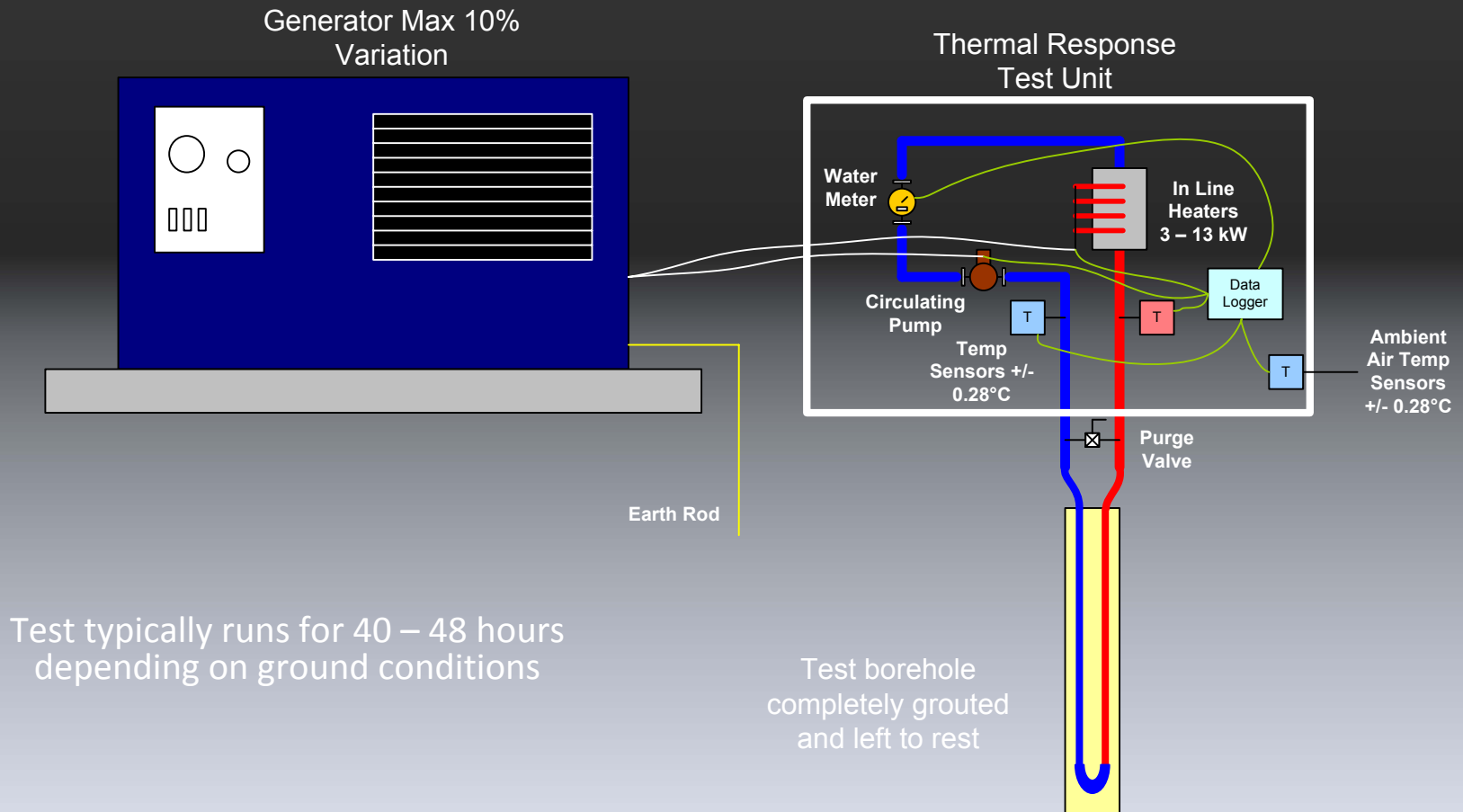


Hole Drilled with Mud in Winter?



Design Info for Closed Loop Systems

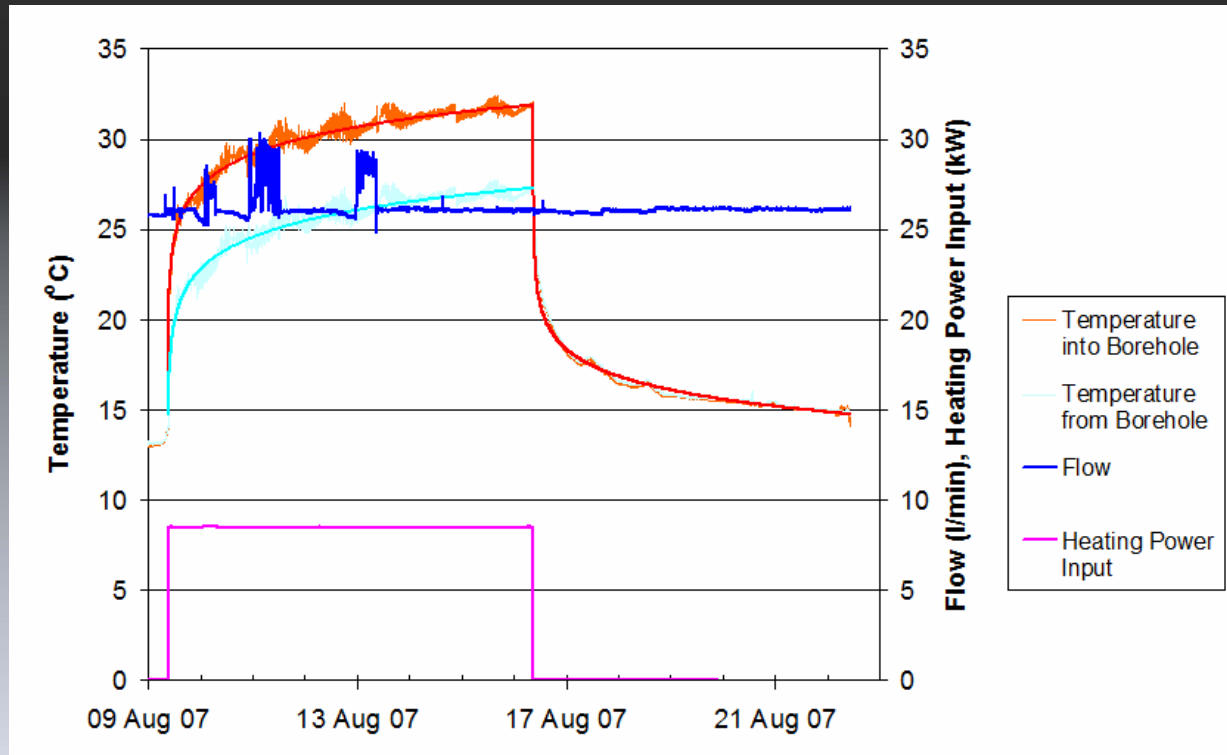
Thermal Response Testing (TRT)



Design Info for Closed Loop Systems

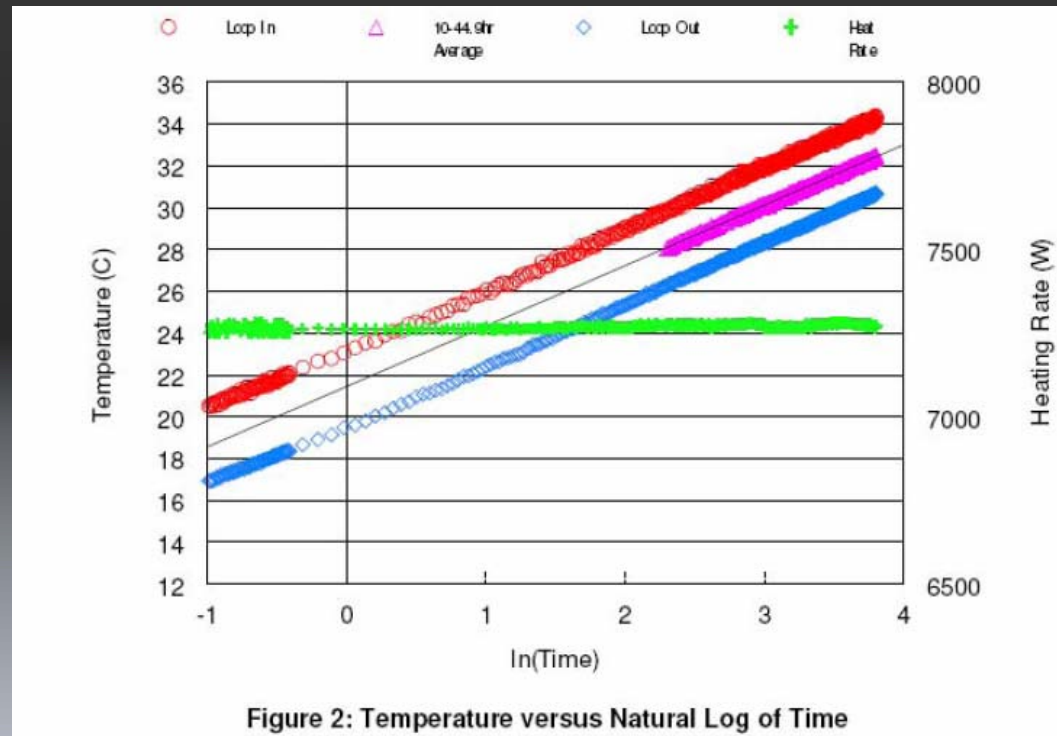
Thermal Response Testing (TRT)

Insulate the TRT unit from the elements. Weather conditions can affect the results of the test and therefore the system design and performance



Design Info for Closed Loop Systems

Thermal Response Testing (TRT)



Steady heat input and flow rate, no external influences, take the time period between 10 and 44 hrs

Driller instruction and specifications

Design Detail

Date: 10th June 2014

Client: Kensa Engineering

Project Number: 494

Project Name: Spalding Housing

Location: Whaplode Drove

Borehole Quantity: 16

Datum point: Ground Level

Borehole Layout Drawing: 494.01.03 Rev B

Design & Geology Report: "140403_Whaplode Drove_Design"



Property Address	Borehole ID	Borehole Diameter	Bore Depth Below Datum	Loop Dia	Double or Single Loop	Loop Installed Depth Below Datum	Grout Type	Grout Conductivity
2, Farrow Rd	1	140	122.5	40	Double	120.0	GSL - Connect	1.78 W/mk
4, Farrow Rd	2	140	122.5	40	Single	120.0	GSL - Connect	1.78 W/mk
6, Farrow Rd	3	140	122.5	40	Single	120.0	GSL - Connect	1.78 W/mk
6, Farrow Rd	4	140	122.5	40	Single	120.0	GSL - Connect	1.78 W/mk
10, Farrow Rd	5	140	122.5	40	Single	120.0	GSL - Connect	1.78 W/mk
12, Farrow Rd	6	140	122.5	40	Single	120.0	GSL - Connect	1.78 W/mk
1, Coppers Close	7	140	121.0	40	Single	118.5	GSL - Connect	1.78 W/mk
2, Coppers Close	8	140	121.0	40	Single	118.5	GSL - Connect	1.78 W/mk
3, Coppers Close	9	140	121.0	40	Single	118.5	GSL - Connect	1.78 W/mk
4, Coppers Close	10	140	121.0	40	Single	118.5	GSL - Connect	1.78 W/mk
1, Greenbank	11	127	83.0	32	Single	80.5	GSL - Connect	1.91 W/mk
2, Greenbank	12	127	83.0	32	Double	80.5	GSL - Connect	1.91 W/mk
3, Greenbank	13	127	83.0	32	Double	80.5	GSL - Connect	1.91 W/mk
4, Greenbank	14	127	83.0	32	Single	80.5	GSL - Connect	1.91 W/mk
1, Chapel Gate	15	127	87.0	32	Single	84.5	GSL - Connect	1.91 W/mk
3, Chapel Gate	16	127	87.0	32	Single	84.5	GSL - Connect	1.91 W/mk

Note the reference to the design and geology report and the borehole layout drawings

Driller instruction and specifications

Drilling Instruction

*Expert Geothermal
Drilling Ltd*

Date: 10th June 2014
Client: Kensa Engineering
Project Number: 494
Project Name: Spalding Housing
Location: Whaplode Drove
Borehole Quantity: 16
Datum point: Ground Level
Borehole Layout Drawing: 494.01.03 Rev B
Design & Geology Report: "140403_Whaplode Drove_Design"

Property Address	Borehole ID	Borehole Diameter	Drilling Method	Additives / Mixture	Bore Depth Below Datum	Site Access Requirements	Estimated Rest Water Level	Casing Requirements	Special Instruction
2, Farrow Rd	1	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	122.5	Track Boards	3 m artesian head	Through drift and 10 m into solid clay	Resident requires disabled access
4, Farrow Rd	2	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	122.5	Track Boards	3 m artesian head	Through drift and 10 m into solid clay	Resident requires disabled access
6, Farrow Rd	3	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	122.5	Lift Garden Slabs and track boards	3 m artesian head	Through drift and 10 m into solid clay	Pristine garden
6, Farrow Rd	4	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	122.5	Lift Garden Slabs and track boards	3 m artesian head	Through drift and 10 m into solid clay	Abrasive resident
10, Farrow Rd	5	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	122.5	Move and store azalea and track boards	3 m artesian head	Through drift and 10 m into solid clay	N/A
12, Farrow Rd	6	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	122.5	Track Boards	3 m artesian head	Through drift and 10 m into solid clay	Tight access next to garden wall
1, Coppers Close	7	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	121.0	Track Boards	1 m artesian head	Through drift and 10 m into solid clay	N/A
2, Coppers Close	8	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	121.0	Track Boards	1 m artesian head	Through drift and 10 m into solid clay	Take out gate post and remove gates
3, Coppers Close	9	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	121.0	Track Boards	1 m artesian head	Through drift and 10 m into solid clay	N/A
4, Coppers Close	10	140	Fluid Flush - Bentonite	40 Sec Viscosity / Weight Agents	121.0	Track Boards	1 m artesian head	Through drift and 10 m into solid clay	N/A
1, Greenbank	11	127	Air Flush	Water mist injection	83.0	Work from hard standing	10 m below ground level	As required for ease of drilling	Abrasive resident
2, Greenbank	12	127	Air Flush	Water mist injection	83.0	Work from hard standing	10 m below ground level	As required for ease of drilling	Tight access next to hedge
3, Greenbank	13	127	Air Flush	Water mist injection	83.0	Work from hard standing	10 m below ground level	As required for ease of drilling	Caravan may need to be moved
4, Greenbank	14	127	Air Flush	Water mist injection	83.0	Work from hard standing	10 m below ground level	As required for ease of drilling	N/A
1, Chapel Gate	15	127	Air Flush	Water mist injection	87.0	Work from hard standing	8 m below ground level	As required for ease of drilling	new build / other trades on site
3, Chapel Gate	16	127	Air Flush	Water mist injection	87.0	Track Boards	8 m below ground level	As required for ease of drilling	new build / other trades on site

Driller instruction and specifications

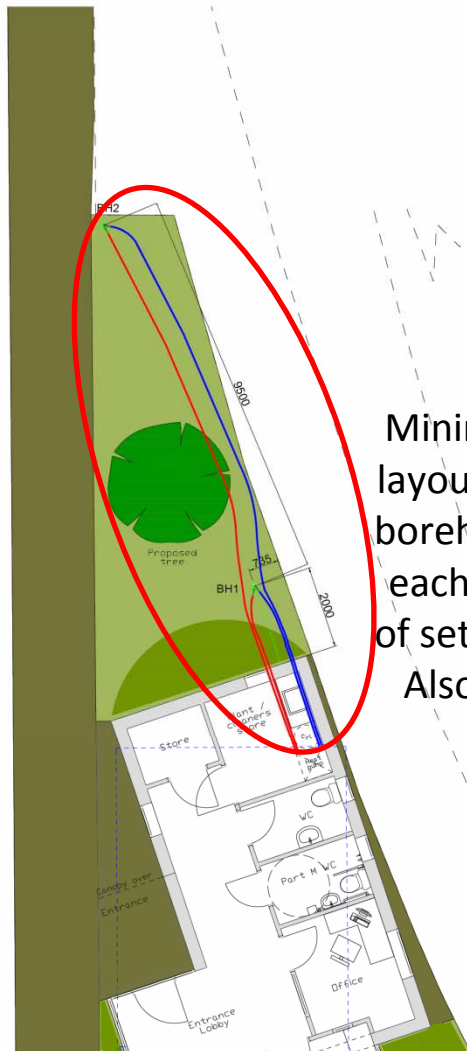
Completion Instruction

Date: 10th June 2014
Client: Kensa Engineering
Project Number: 494
Project Name: Spalding Housing
Location: Whaplode Drove
Borehole Quantity: 16
Datum point: Ground Level
Borehole Layout Drawing: 494.01.03 Rev B
Design & Geology Report: "140403_Whaplode Drove_Design"

Expert
Geothermal

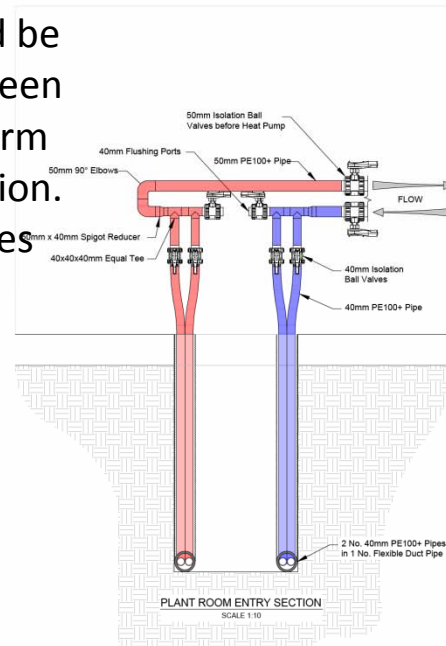
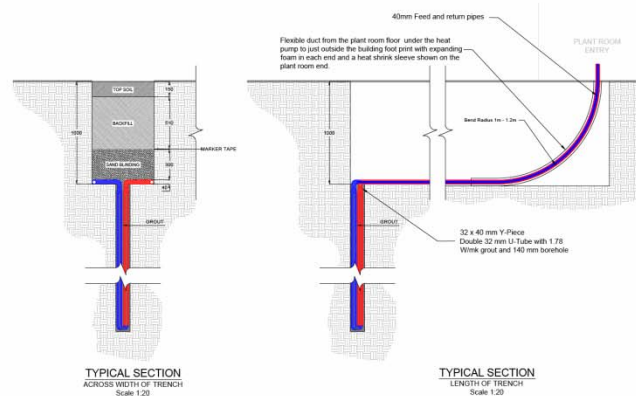
Property Address	Borehole ID	Loop Installed Depth Below Datum	Loop Dia mm	Double or Single Loop	Weights required	Grout Type	Grout Conductivity	Sanitisation	Loop Testing	Loop Completion	Loop Protection
2, Farrow Rd	1	120.0	40	Double	45 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
4, Farrow Rd	2	120.0	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
6, Farrow Rd	3	120.0	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
6, Farrow Rd	4	120.0	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
10, Farrow Rd	5	120.0	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
12, Farrow Rd	6	120.0	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
1, Coppers Close	7	118.5	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
2, Coppers Close	8	118.5	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
3, Coppers Close	9	118.5	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
4, Coppers Close	10	118.5	40	Single	25 kg under the loop	GSL - Connect	1.78 W/mk	R500C Biocide 1 %	Flow and Pressure test	Fused caps above ground level	Hi Viz tape above ground level
1, Greenbank	11	80.5	32	Single	15 kg under the loop	GSL - Connect	1.91 W/mk	Potable water only	Flow and Pressure test	Fused caps below ground level	Stop Cock Cover at ground level
2, Greenbank	12	80.5	32	Double	20 kg under the loop	GSL - Connect	1.91 W/mk	Potable water only	Flow and Pressure test	Fused caps below ground level	Stop Cock Cover at ground level
3, Greenbank	13	80.5	32	Double	20 kg under the loop	GSL - Connect	1.91 W/mk	Potable water only	Flow and Pressure test	Fused caps below ground level	Stop Cock Cover at ground level
4, Greenbank	14	80.5	32	Single	15 kg under the loop	GSL - Connect	1.91 W/mk	Potable water only	Flow and Pressure test	Fused caps below ground level	Stop Cock Cover at ground level
1, Chapel Gate	15	84.5	32	Single	15 kg under the loop	GSL - Connect	1.91 W/mk	Potable water only	Flow and Pressure test	Fused caps below ground level	Stop Cock Cover at ground level
3, Chapel Gate	16	84.5	32	Single	15 kg under the loop	GSL - Connect	1.91 W/mk	Potable water only	Flow and Pressure test	Fused caps below ground level	Stop Cock Cover at ground level

Driller instruction and specifications



BOREHOLE LOCATION
SCALE - 1:50

Minimum information on layout drawings should be borehole spacing between each one and some form of setting out information. Also, details of services where possible.



IMPORTANT NOTE: This drawing must be installed as drawn as closely as possible and any deviation required must be notified to the designer for further assessment.

Related documents This drawing must be read in conjunction with the appropriate Specification(s).

Warning Do not scale this drawing. Verify all dimensions and structural details on site. If in doubt, ask before acting

Copyright This drawing is copyright and may not be altered, reproduced or used other than for the Contract Works for which it is issued without the written permission of GSC Ltd

Trenches The Contractor must at all times observe industry best practice where excavations are concerned. Mitigation measures must always be employed where there is a risk to employees, the public or plant from open excavations and suitable barriers should be erected to minimise the risk of people or plant falling into trenches. Excavations should also be made safe by shoring or battering the sides, especially if there is a risk to personnel working within. Your attention is drawn to the 'Groundworks' section of HSE publication 'Health and Safety in Construction' 3rd edition 2006 ISBN 0 7176 6182 2 and any other current legislation and guidelines.

NOTE:

1. ALL pipework to be SDR11 PE100+

[illegible]

Nottingham City Homes
Winwood Centre
Woodthorpe

Scale	Project Ref	Designed by	Drawn by	CHKD by	Date
AS STATED	483	ADH	FW	ADH	23/2/2014

Free Download 

Unit 5 Tel: +44 (0)2476 829762

People & Advice Business Park
Weddington Road
Runcorn
Wirrancheshire
CH9 0DP

For: +44 (0)172 193 4772
e-mail: info@gauch.co.uk
Website: www.gauch.co.uk

Green Thermal Excellence by Design

GAUCH CONSULT Ltd

DRAWING NUMBER	DRAWING TITLE	REVISION
483.01.0A	Borehole Locations & Typical Detail	A

Driller instruction and specifications

Applicable Standards and Guidance



Closed-loop Vertical Borehole Design, Installation & Materials Standards

**Issue 1.0
September 2011**

**GSHP
association**

Published & Copyright © by
Ground Source Heat Pump Association
National Energy Centre,
Davy Avenue,
Knowlhill,
Milton Keynes
MK5 8NG

T: 01908 354545
F: 01908 665577

Email: info@GSHP.org.uk



Driller instruction and specifications

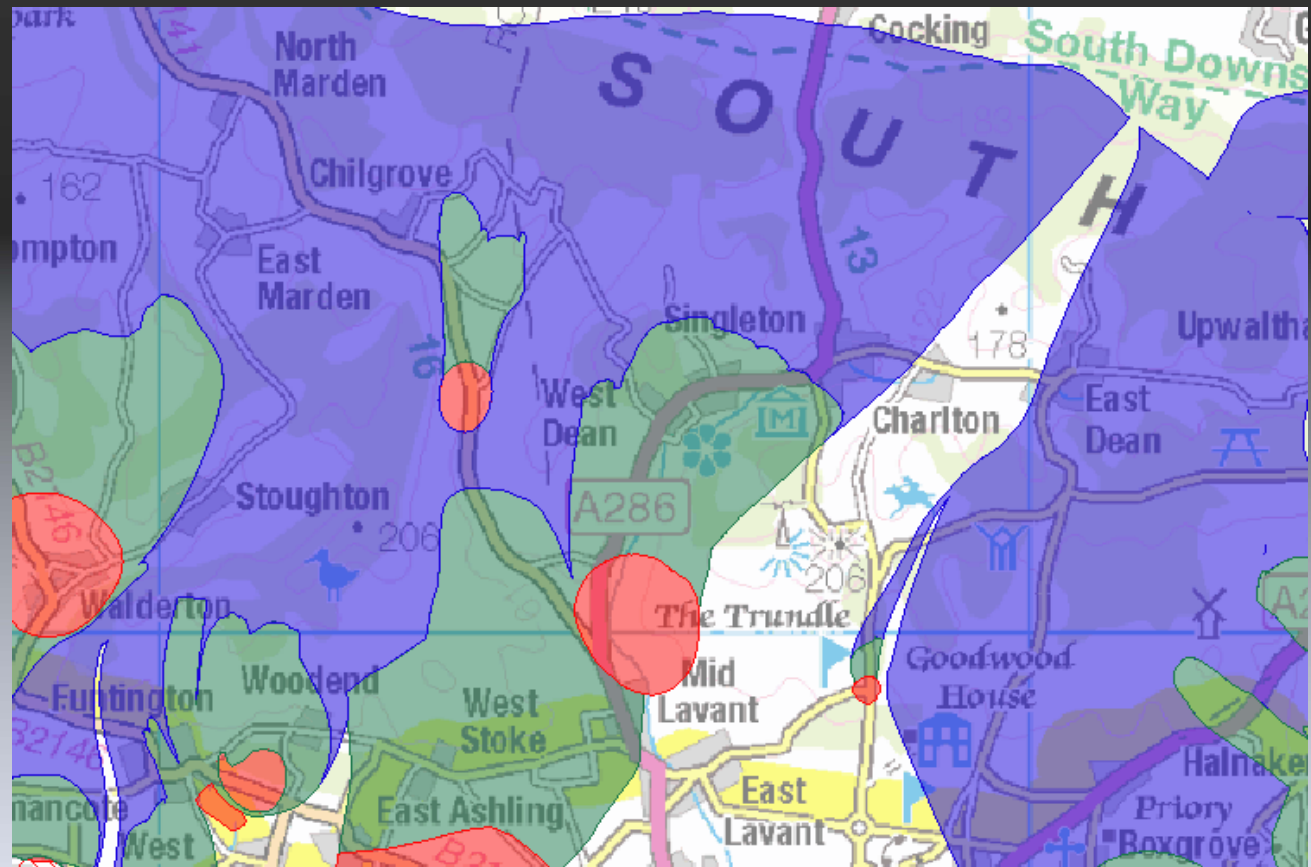
Environment Agency have Source Protection Zones (SPZ's).
Ensure that these have been checked

Total
Catchment

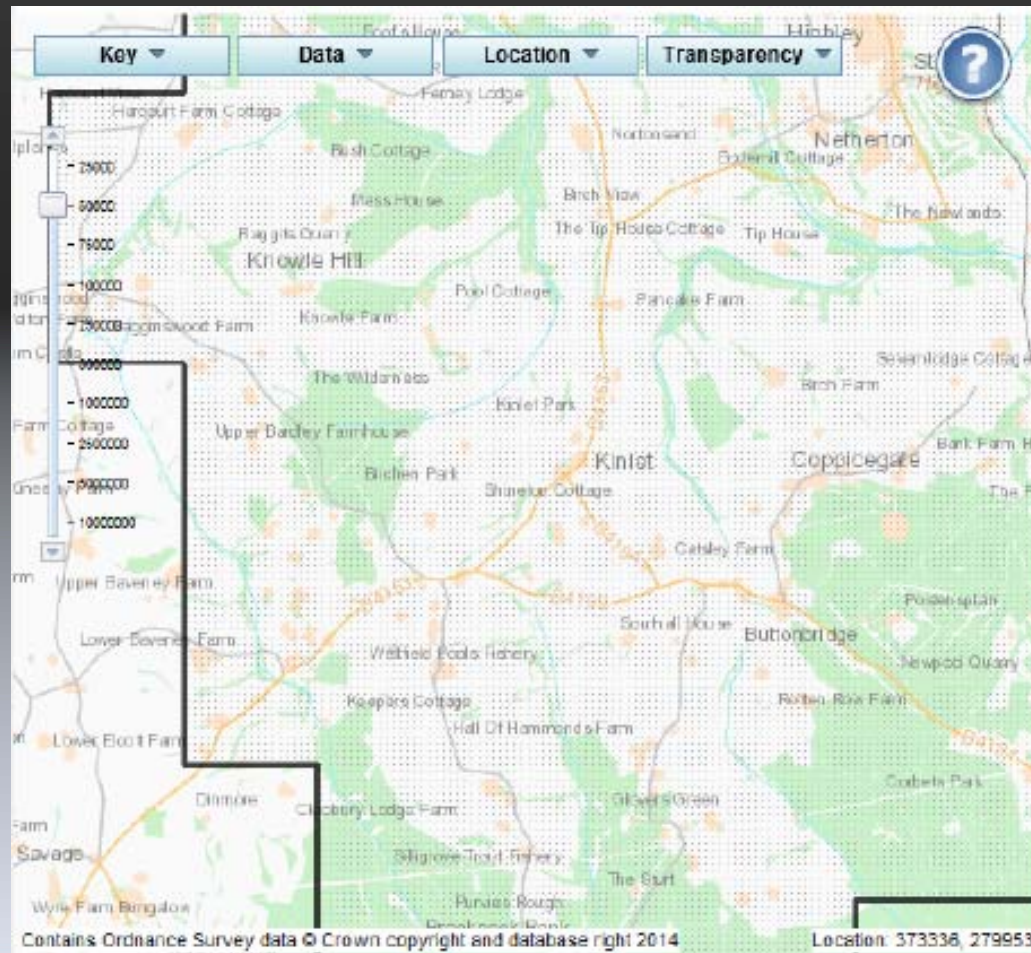
Outer
Zone

Inner
Zone

Special
Interest



Coal Authority Reporting Area



What can go wrong

Without detailed instructions, drawings and dimensions, things can and do go wrong.

Change	Impact	Extra Loop	Other Impacts
Reduce Spacing from 11 to 5 m	Heat Pump Entering temperature reduced from 0°C to -5.5°C	42%	No longer complies with MCS after just 4 years
Install single loop when double is designed	Heat Pump Entering temperature reduced from 0°C to -2.5°C	15%	Head loss in the loop goes from 4 m to 20 m head No longer complies with MCS after 8 years
Use Std Bentonite and not Thermally Enhanced Grout	Heat Pump Entering temperature reduced from 0°C to -3°C	18%	No longer complies with MCS after 7 years
Get all three wrong	Heat Pump Entering temperature reduced from 0°C to -12°C	82%	Doesn't comply with MCS from year 1

What can go wrong

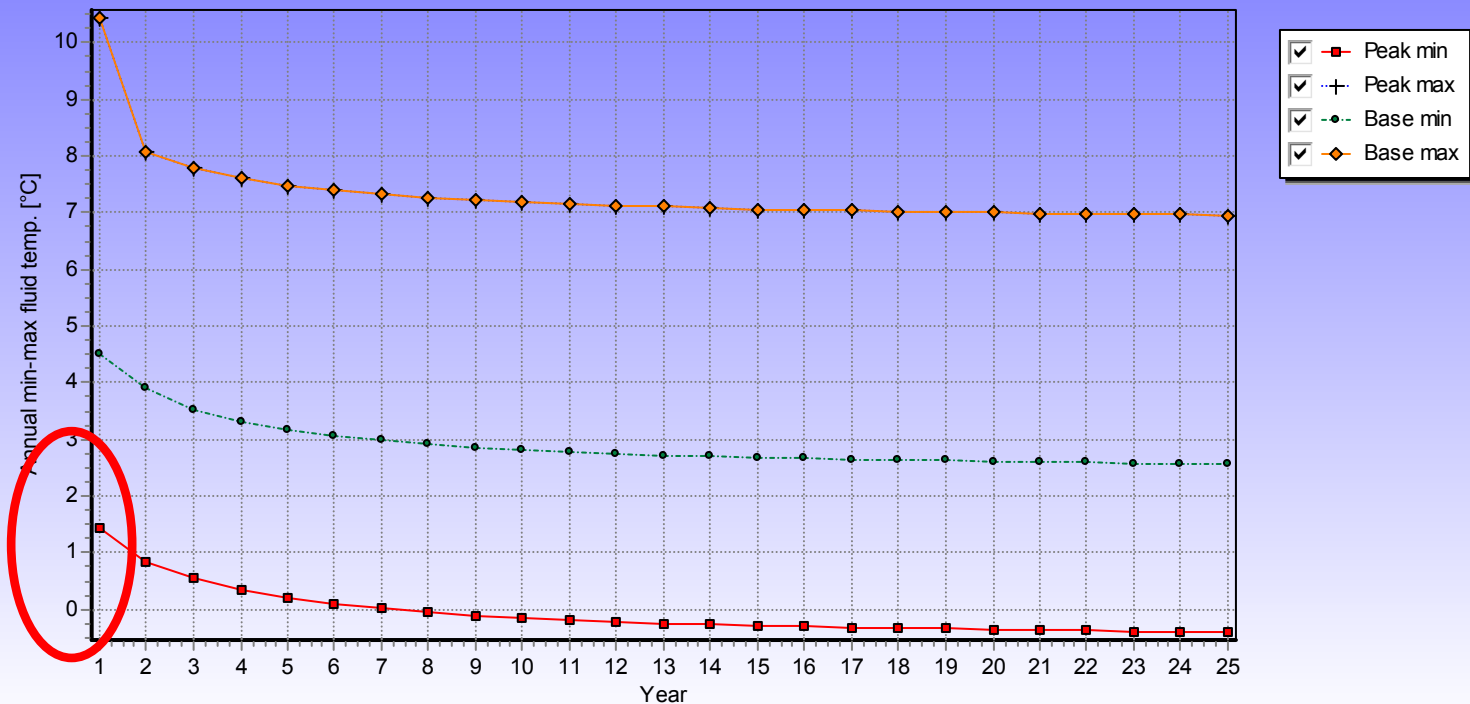
Just a few other things to be aware of

- Boreholes in wrong positions can interfere with other services on site
- Boreholes that are not flow and pressure tested are not complete
- Boreholes that are not protected as instructed are not complete
- Changing the number and depth of holes impacts the performance and hydraulics
- Drilling in Source Protection Zones can impact nearby sources with drilling fluids for example
- Drilling without checking for mine works can create unstable surfaces for the rigs and can lead to gas escaping or spontaneous combustion of seams

What can go wrong

Driller says...

“On this house I couldn’t get the loop in past 65 m so I cut it in half and put two in to 55 m is that OK” ??



If he had asked then a re-design is pretty easy. 2 holes to 60 m in series

What can go wrong

Beware the employer or contractor asking drillers to change things because it suits them better !!

Resident didn't want to move his caravan and so asked the driller to drill on the white dot !



Unauthorised re-design by the dog !!
He moved half of the pin flags that marked out the holes !!



Only the designer can change the design !

Q & A on session 2

Any questions....

Any slides you want to go back to?

Break for Lunch