

Flood defence retaining walls

Everything you need to know about flood defense walls



Bob Evans

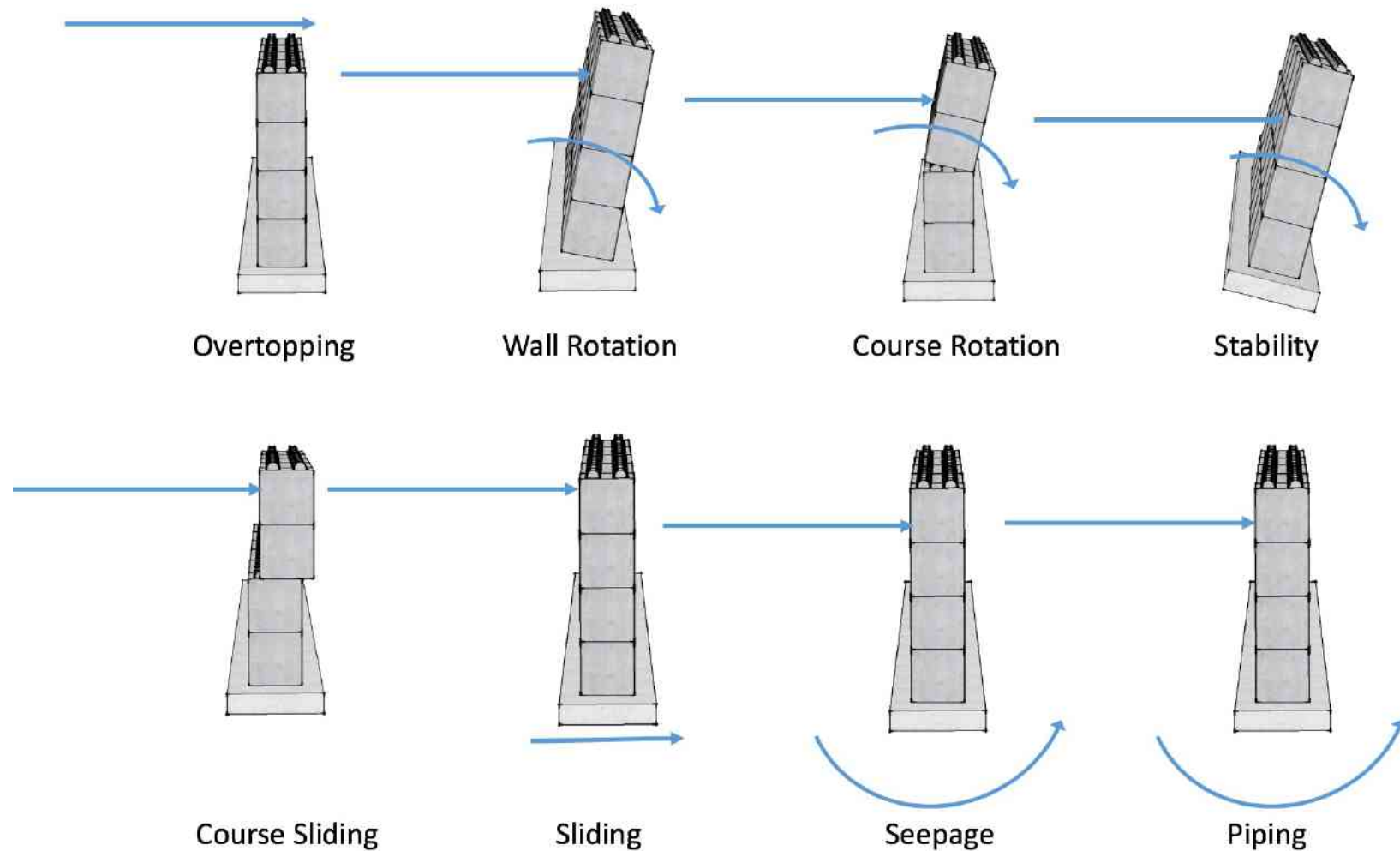


Flood risk and flood defense walls



Flood map

Retaining Wall Solutions



Overtopping - The material being retained creates a force (moment) that causes toppling of the wall. The weight of a gravity retaining wall resists this moment.

Bearing capacity - The weight of the wall and earth is supported by the base. The ground bearing capacity needs to be checked to ensure any settlement is within limits.

Sliding - The material being retained creates a horizontal force that can cause the retaining wall to slide. This is resisted by the friction between the wall and earth beneath and the embedment of the wall.

Stability - The earth around the wall requires adequate strength to avoid an overall slip failure.

Shear - The blocks can shear at the base or between courses. We introduce a kicker at the base and interlocking buttons to resist these forces

Seepage - Water seeping underneath the foundation

Piping - When seeping become faster and flowing this then becomes piping that can cause the wall to slide and rotate. The solution is to build a cut off. This is an extended to, see the sketches on the next page.

Flood defense wall design

1. Planning
2. Design
3. Construction

The planning phase

- Obtaining local flood maps, a Google Earth map and spot levels will help determine the wall's layout and height.
- Carry out a soil investigation and record the findings.
- Carry out a utility search to find the location of all underground services, including gas, electric, telephone, and internet cables.
- Carry out a manhole survey to find the depth and location of all foul and surface water drains.
- Draw a plan for the wall, including dimensions, openings, services and ground levels.
- Design the foundation for depth and type using the soil and wall height data.
- Create a fully priced bill of quantities to give an accurate budget using the foundation and wall plan.
- Create a design brief for the structural engineer by pulling all the relevant information into a file.
- Use the soil investigation data to design the sump pump sizes and layout.
- Ensure the finance is in place including any grants that may be available before starting the construction phase.

Soil Investigation

Drill our a 150mm diameter hole using a hand auger to a depth of 1m

Take samples of soil measuring the depth of any soil type change

Take photographs of the soil

Take a sample of soil and squeeze it in your hand and describe what happens and take a photograph.





Soil field test to obtain ground bearing pressure



5.5 hours to drain



1 minute to drain

Porosity Test

Fill the hole with water and leave for ten minutes. Fill the hole again and note the time.

Describe what happens over the next few hours.

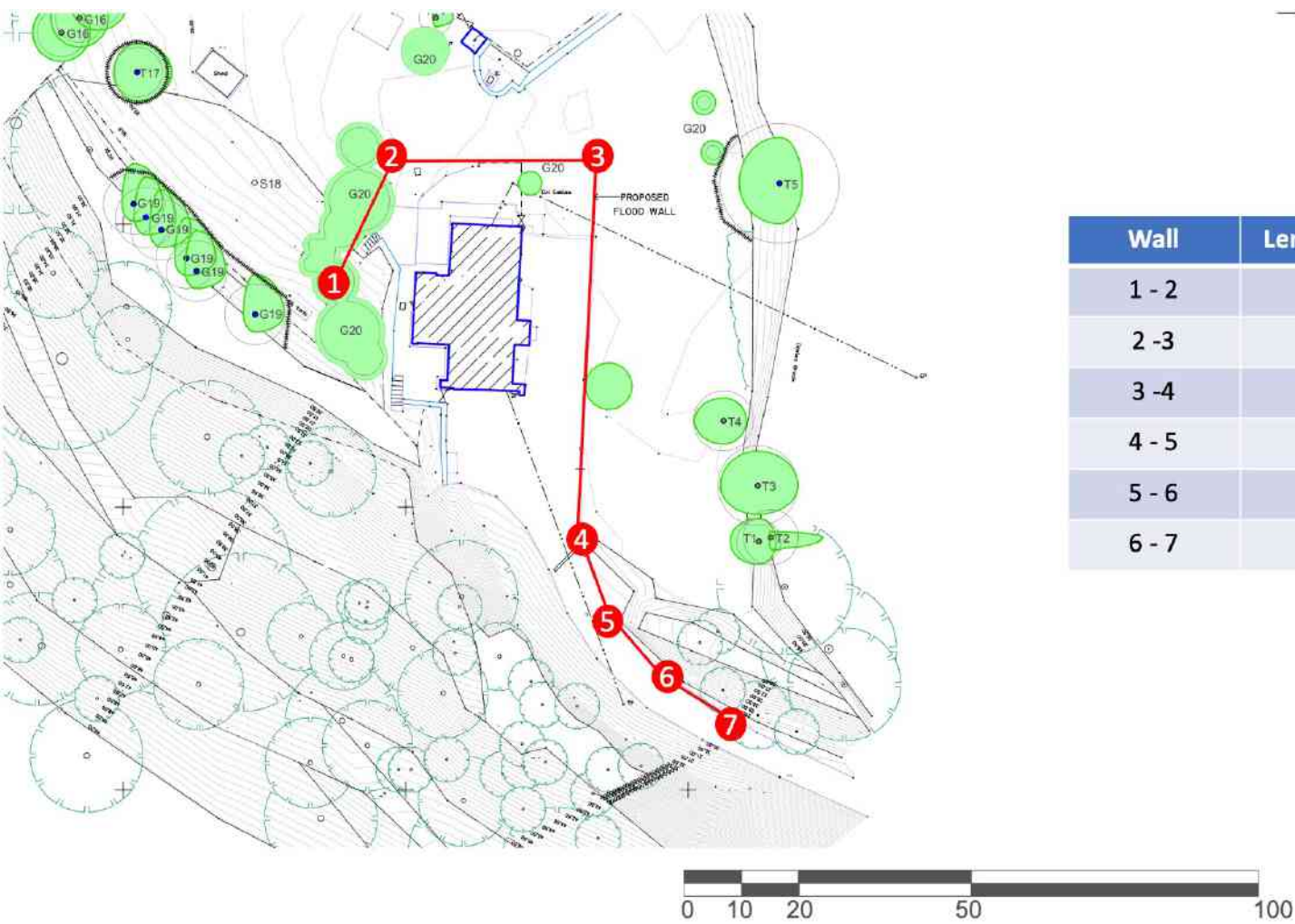
If water remains in the hole, what depth is the water when it became stable.

If the water drained away, how long did it take to drain away?

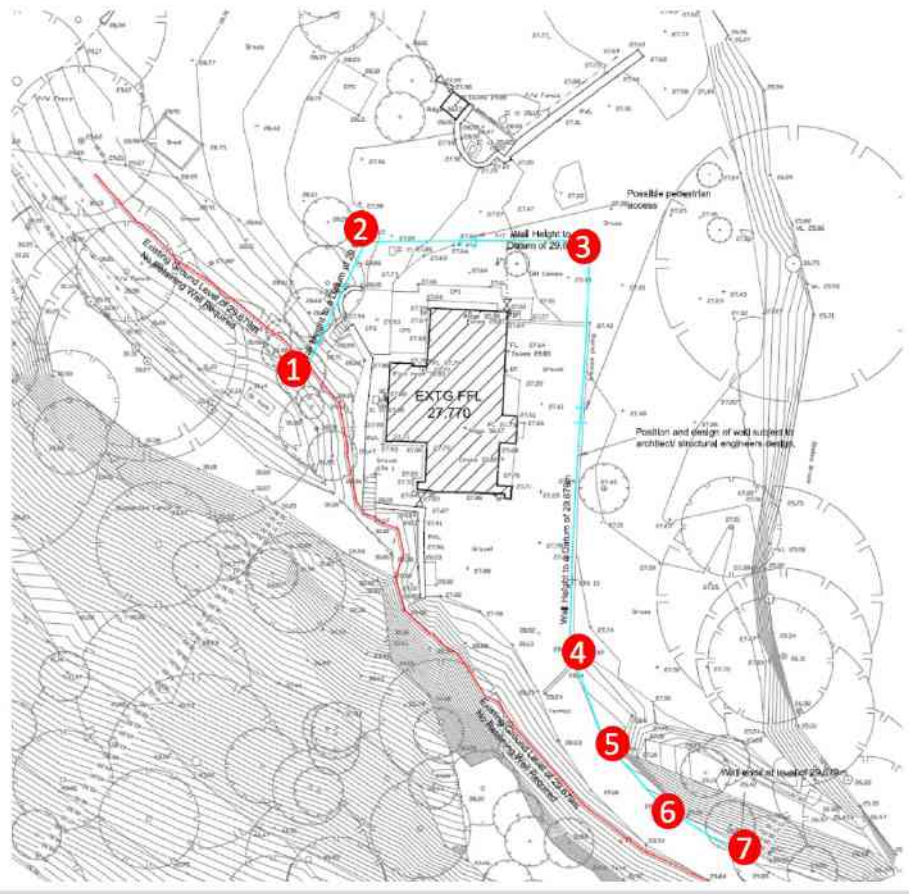
We will use this information for the pump design

A simple porosity test

Retaining Wall Solutions



Wall	Length (m)
1 - 2	13
2 - 3	18
3 - 4	32
4 - 5	5
5 - 6	4
6 - 7	4



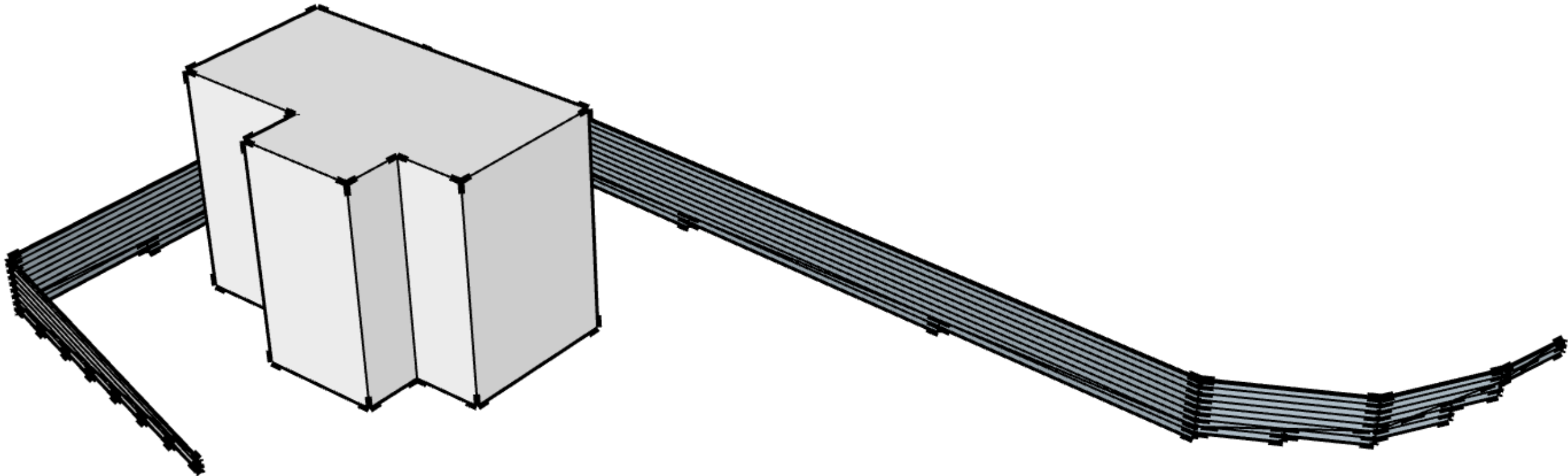
FFL Building 27.770 + 1.80m

Top of Wall (TOW) = 29.570

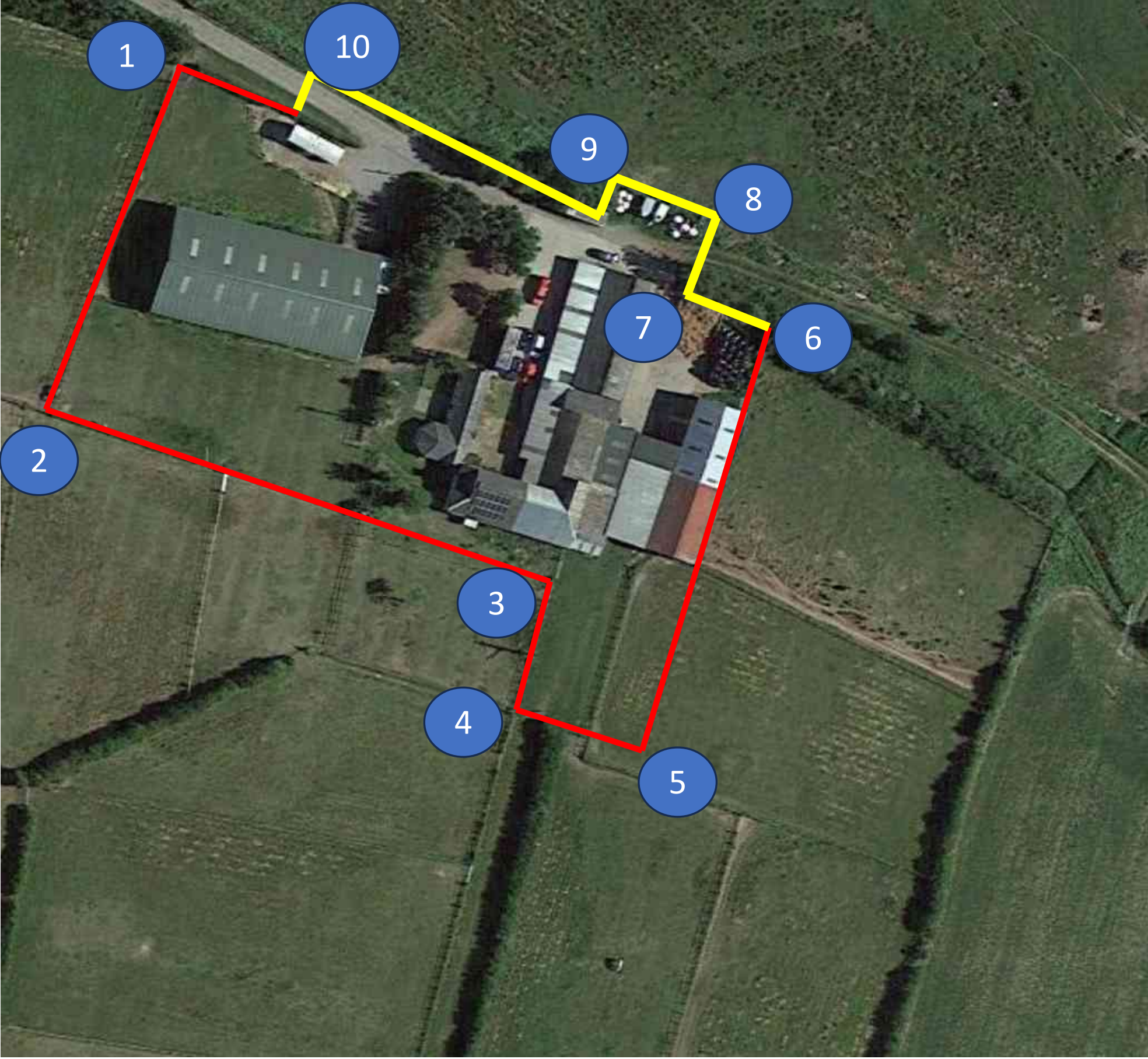
TOW = 29.60 to keep it simple

Position	GL	Wall Height
1	29.6	0.00
2	28.0	1.6
3	27.3	2.3
4	28.0	1.6
5	28.5	1.1
6	29.2	0.4
7	29.8	-0.2

Site survey to obtain ground levels

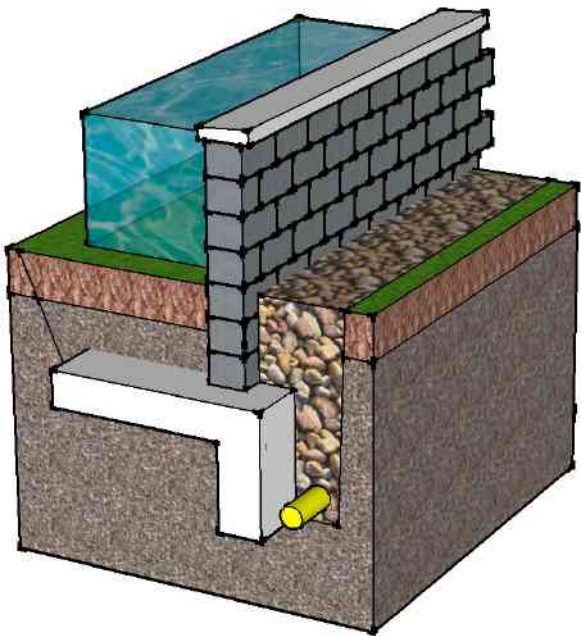


Stepped foundation to suit ground levels



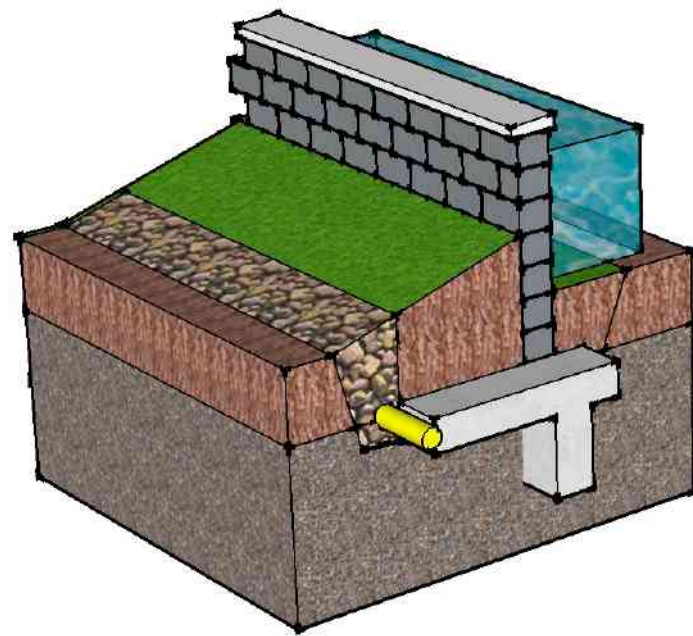
Top of wall level 7.2
0.5% change of happening in one year

Ref	Level	height
1	6.30	0.90
2	6.76	0.44
3	6.90	0.30
4	6.85	0.35
5	6.92	0.28
6	6.40	0.80
7	6.45	0.75
8	5.71	1.49
9	6.00	1.2
10	6.34	0.86



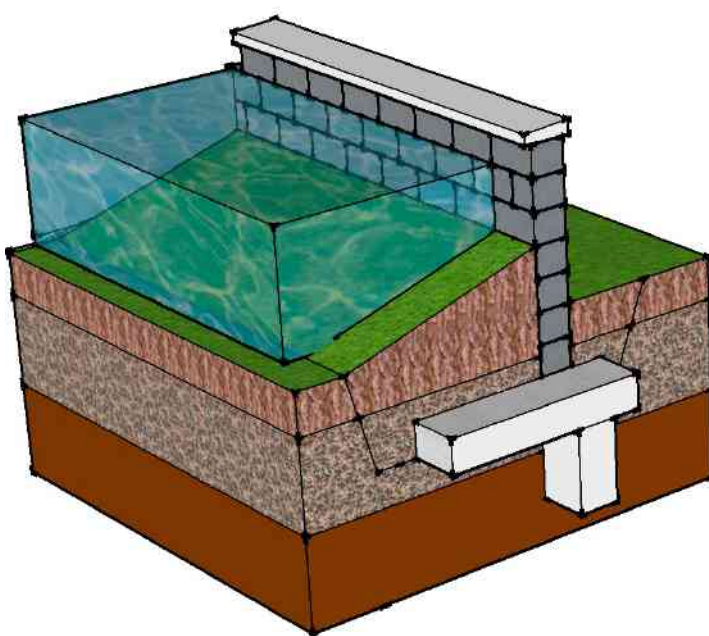
Foundation in
sand/gravel soil

Wet side on flat surface



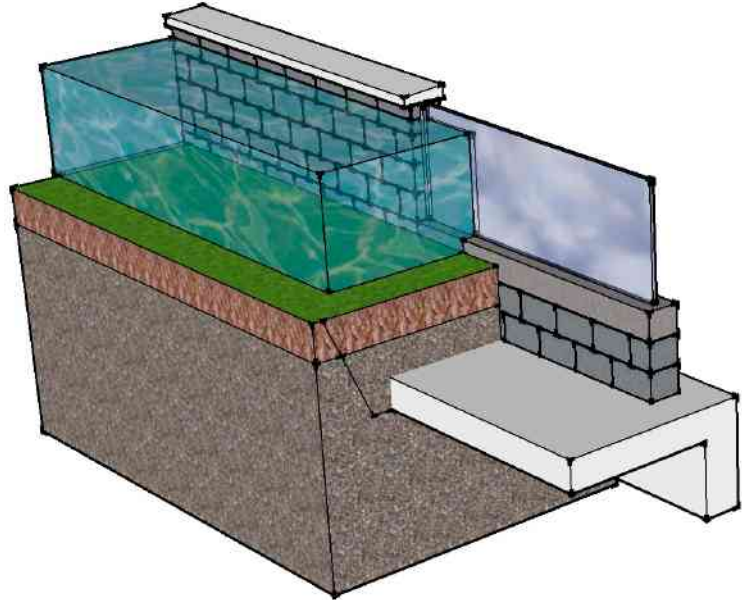
Foundation in sand/gravel
soil

Dry side on bank of
excavated spoil



Foundation in clay soil

Wet side on bank of
excavated spoil



Glass wall type when a
view is required

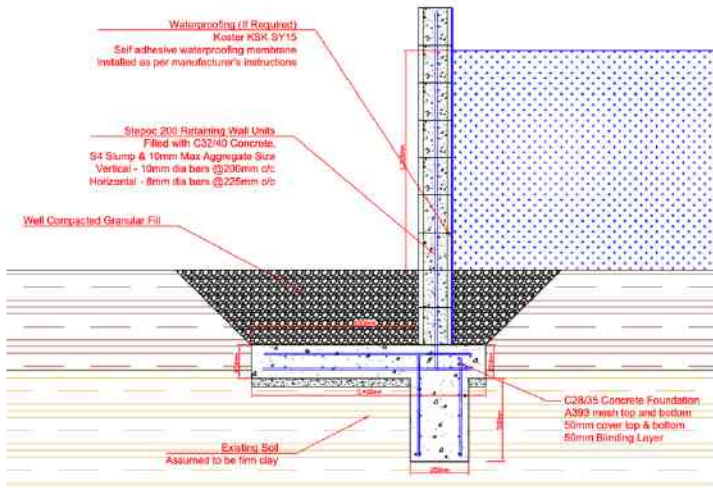
STEPOC T SECTION FLOOD DEFENCE WALL

Budget for finance

Variables	Length	Height	Foundation width	Foundation depth	Foundation excavation depth
	108	2.025	1.4	0.25	0.75
	Area	Cavity Width	Key width	Key depth	
	218.7	0.15	0.35	0.5	

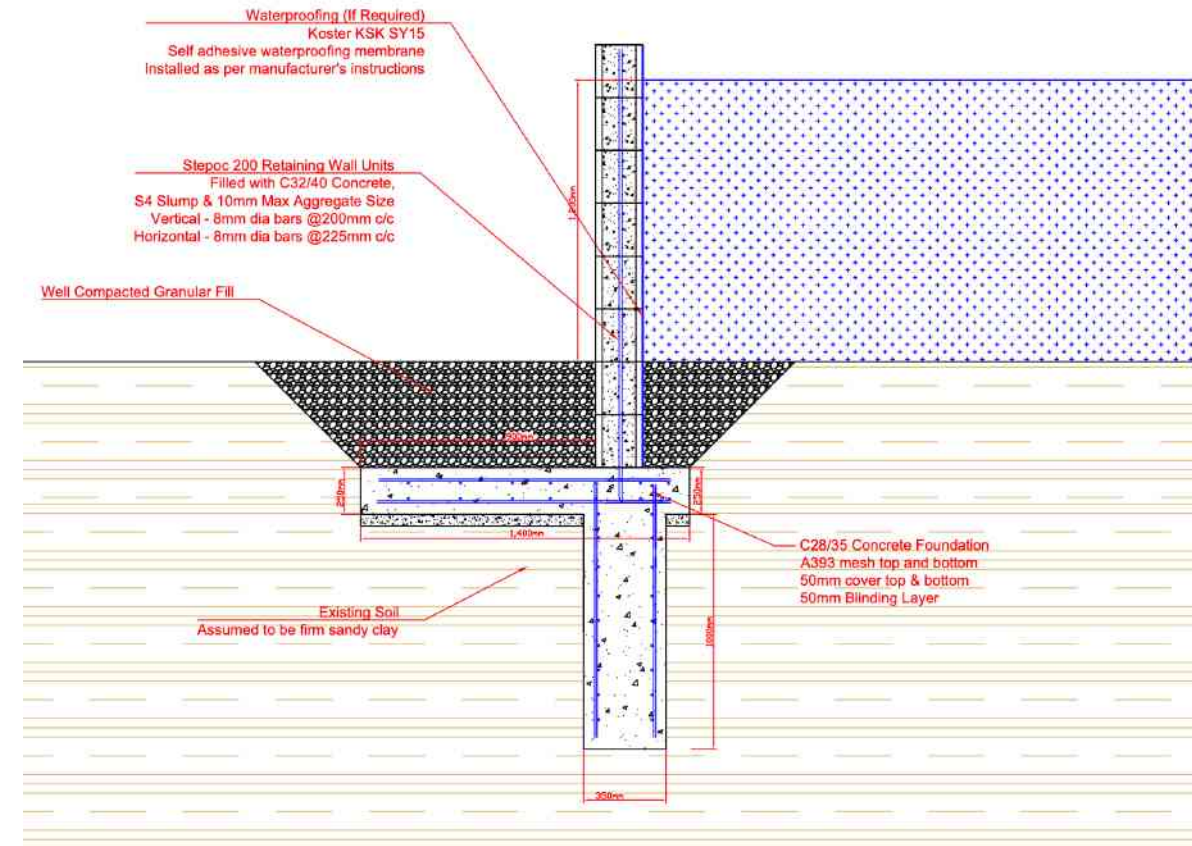
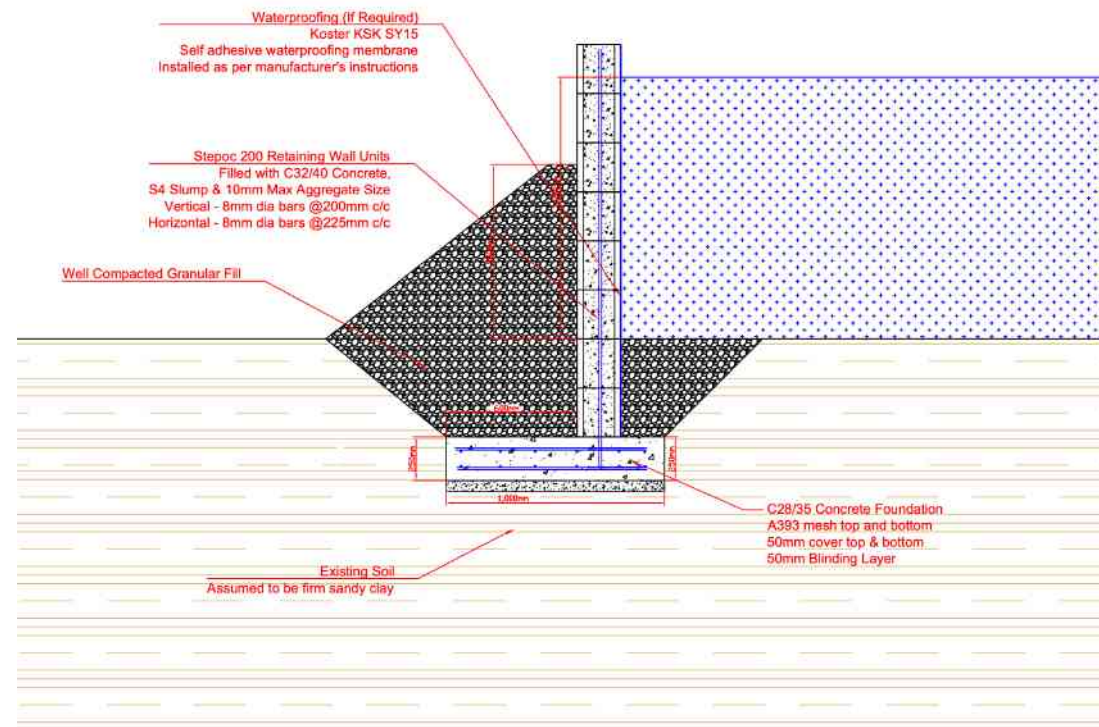
Description of Work						Quantity	Unit	Rate	Extention
Preliminaries									
1	Supervision	0	day	£	-	£	-		
2	Traveling and accomodation	0	day	£	-	£	-		
3	Strucural design of the wall and cost plan	0	Item	£	-	£	-		
Measured Work									
4	Excavate foundation trench	132	m3	£	14.38	£	1,901.81		
5	Excavte working space	49	m3	£	14.38	£	698.63		
6	Move spoil to spoil heap	132	m3	£	14.38	£	1,901.81		
7	Remove inert spoil off site 16 ton grab	0	m3	£	57.50	£	-		
8	Level and ram bottom of excavation	151.2	m2	£	1.15	£	173.88		
9	C15 Blinding concrete	8	m3	£	189.75	£	1,518.00		
10	Formwork to side of foundation ne 300mm dp	216	m	£	10.35	£	2,235.60		
11	C28/35 to foundation	56.7	m3	£	203.55	£	11,541.29		
12	A393 10mm x 10mm 200x200 6.16 kg/m2	410	m2	£	9.78	£	4,011.66		
13	Stepoc 200mm hollow blocks	219	m2	£	106.15	£	23,213.91		
14	Steel reinforcement to wall 7kg m2	219	m2	£	12.08	£	2,640.80		
15	Concrete coping stone	108	m2	£	24.15	£	2,608.20		
16	C32/40 10mm agg to block cavity	16	m2	£	236.90	£	3,837.78		
							£	56,283.37	
							£	257.35	m2

Margin		15%																			
Labour				Plant		Material				Margin		Rate				Profit					
£	-	£	-	£	-	£	-	£	-	£	-	£	-	£	-	£	-				
£	-	£	-	£	-	£	-	£	-	£	-	£	-	£	-	£	-				
£	-	£	-	£	-	£	-	£	-	£	-	£	-	£	-	£	-				
£	5.00	£	661.50	£	7.50	£	992.25	£	-	£	12.50	£	1.88	£	14.38	£	248.06				
£	5.00	£	243.00	£	7.50	£	364.50	£	-	£	12.50	£	1.88	£	14.38	£	91.13				
£	5.00	£	661.50	£	7.50	£	992.25	£	-	£	12.50	£	1.88	£	14.38	£	248.06				
£	10.00	£	-	£	40.00	£	-	£	-	£	50.00	£	7.50	£	57.50	£	-				
£	0.50	£	75.60	£	0.50	£	75.60	£	-	£	1.00	£	0.15	£	1.15	£	22.68				
£	25.00	£	200.00	£	-	£	140.00	£	1,120.00	£	165.00	£	24.75	£	189.75	£	198.00				
£	5.00	£	1,080.00	£	-	£	4.00	£	864.00	£	9.00	£	1.35	£	10.35	£	291.60				
£	15.00	£	850.50	£	12.00	£	680.40	£	8,505.00	£	177.00	£	26.55	£	203.55	£	1,505.39				
£	2.00	£	820.80	£	-	£	6.50	£	2,667.60	£	8.50	£	1.28	£	9.78	£	523.26				
£	20.00	£	4,374.00	£	-	£	72.30	£	15,812.01	£	92.30	£	13.85	£	106.15	£	3,027.90				
£	4.00	£	874.80	£	-	£	6.50	£	1,421.55	£	10.50	£	1.58	£	12.08	£	344.45				
£	6.00	£	648.00	£	-	£	15.00	£	1,620.00	£	21.00	£	3.15	£	24.15	£	340.20				
£	25.00	£	405.00	£	25.00	£	405.00	£	2,527.20	£	206.00	£	30.90	£	236.90	£	500.58				
		£	10,894.70			£	3,510.00	£	34,537.36									£	7,341.31		
		£	22.00	Lab rate																	
		62	Days																		
		2	Gang size																		
		31	Days duration																		



Structural design phase

The structural engineer will design the wall and deliver a structural report, calculations, and drawing showing the section through the wall, together with a specification.



Structural designs with specification

Construction and project management phase

- Adjust the bill of quantities using the structural engineer's design.
- Create working drawings for site construction
- To place orders, create a shopping list that includes the steel reinforcement bar schedule, reinforcement spaces and blocks, concrete mixes with quantities, and the stepoc block quantities.
- Produce a tender document to go out to tender to obtain competitive prices to build the wall.
- Check the tender prices to ensure the right contractor is selected for the best value.
- Create a time plan bar chart for buying and on-site production to build the wall.
- Monitor on-site works to check the work is being carried out to the structural engineer's specifications.
- Value the work to pay the contractor the correct value without overpaying.

Nick Lupton – Pixham House



Flooding before the flood wall



Pixham house featured on the BBC news

Case Study



Flood map

RetainingWall Solutions



Excavation, reinforced steel, pouring concrete

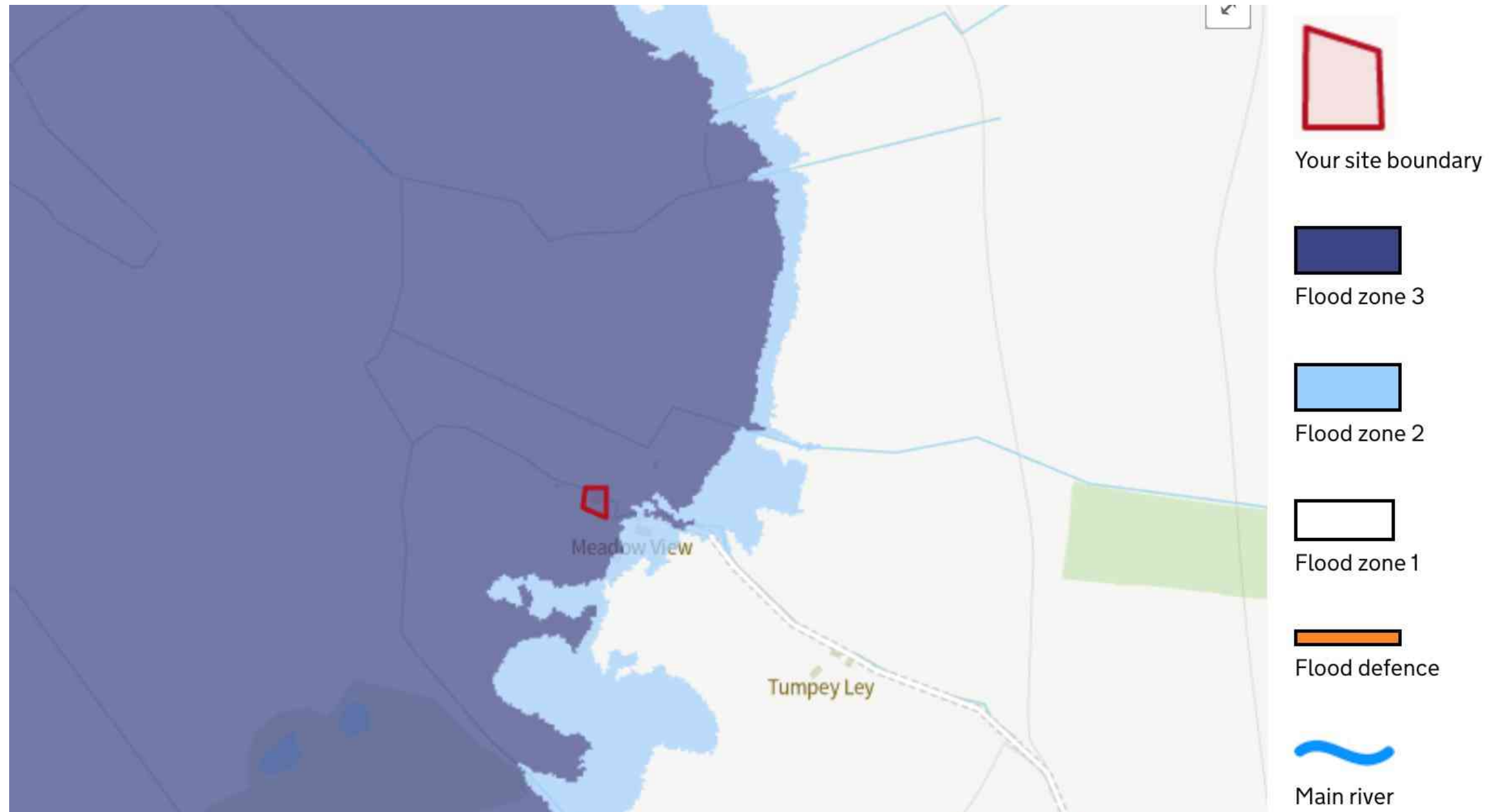


Laying first course of blocks and stepped foundation

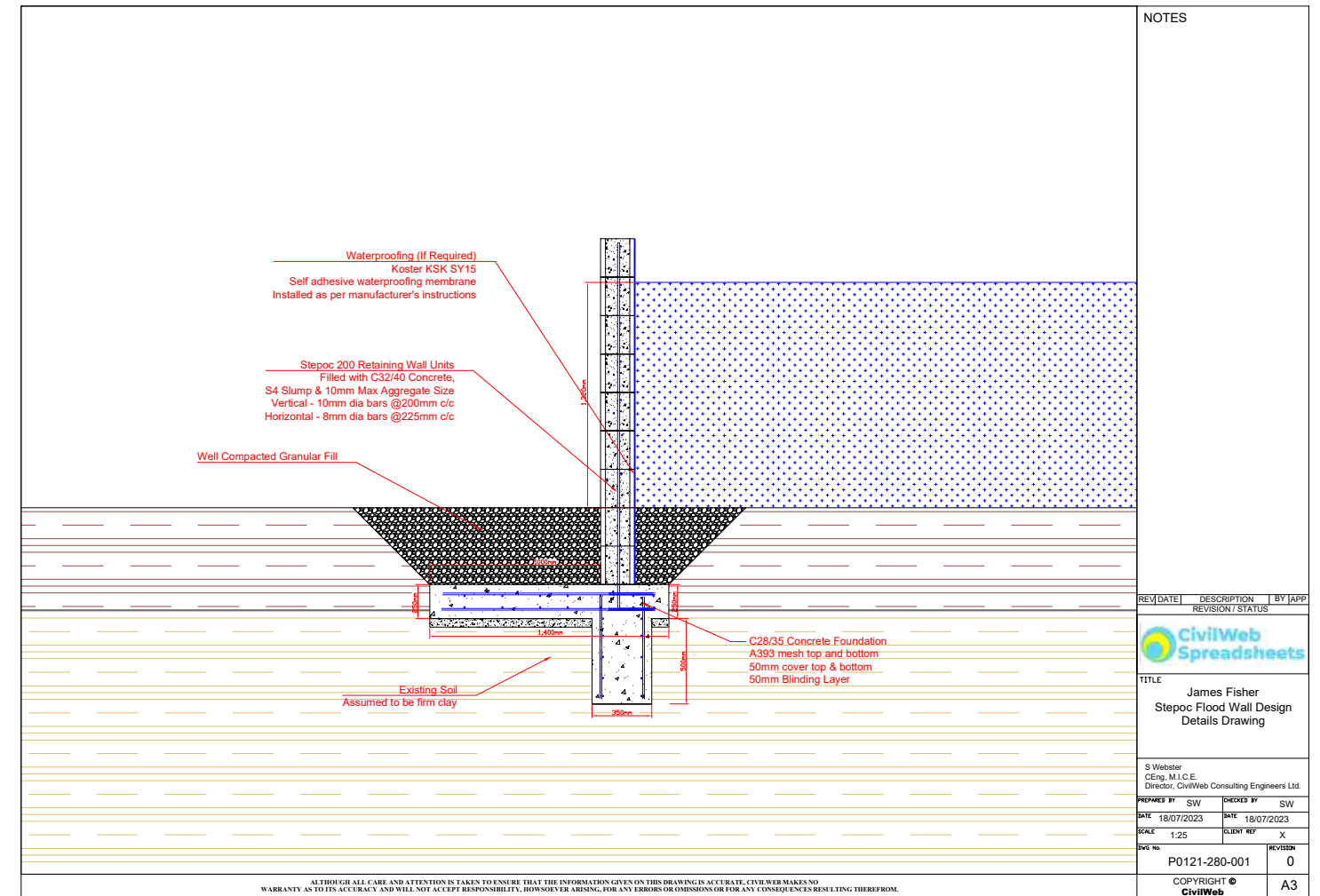
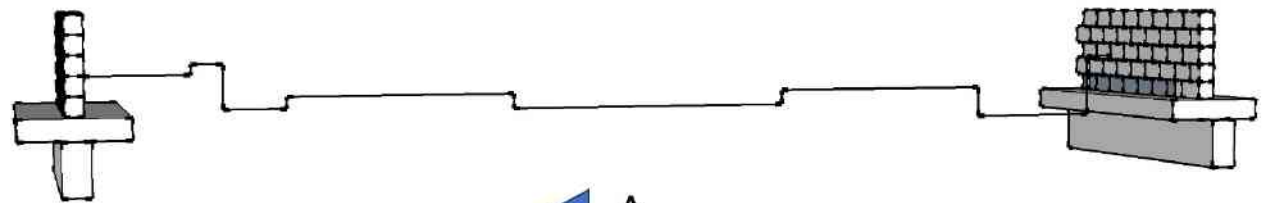


Some features of the flood wall

James Fisher – Worlds End



Flood Map





Steel reinforcement, and pumping concrete



Laying the first layer of blocks



Wall ready for the core concrete

Flood defence retaining walls

The Next Step

- Tell us about your project.
- We are here to support you.



Bob Evans