CAPITA

Memo

16 November 2015

To	Helen Winsall
CC	Simon Gale
Subject	Modelling Approach for Treforest Industrial Estate—Assessment of potential changes in water level following scenario testing

Purpose

To date Capita Property and Infrastructure have drafted the September 2015 Strategic Flood Consequences Assessment (SFCA) with the aim that it would present sufficient information to enable Rhondda Cynon Taf County Borough Council (CBC) to identify the development classes that would be permitted by the Local Development Order (LDO) within the Treforest Industrial area. Following the completion of the SFCA and further discussions with Natural Resource Wales (NRW) it became apparent that further work to quantify the flood risk at the site, should development take place, was needed.

The purpose of this memo is to outline the modelling approach and modelling outputs that was carried out to assess potential changes in the water levels to reflect an increase in the building footprint area and elevation across the site. This memo also reflects the findings of the sensitivity analysis and provides high level development recommendations.

Model Background

For this study the existing River Taff ISIS TUFLOW model developed in 2011 was used. The model was developed as part of the Lower Taff Velocity and Depth Mapping Study. The model was reviewed and updated to the current version of ISIS TUFLOW prior to carrying out any hydraulic assessments. Therefore, the hydraulic model has been run using TUFLOW build 2013-12-AD-iDP-w64 and Flood Modeller Pro v4.1 (rebranded version of ISIS). This software represents the latest version of the software at the time of model construction.

Model Approach

Sub-stations

There are two sub-stations within the study area. These are located in the northern part of the Treforest LDO boundary. The sub-stations are defended up to the 1 in 1000 year return period event including an allowance for climate change with an additional freeboard of 300mm. The proposed perimeter defence line around the site was inserted into the model as a TUFLOW Zline. The required defence level for the sub-station to the east was taken from the modelling report provided by NRW1 (42.86m AOD). The required defence level for the sub-station to the west was taken from the FRA report provided by NRW2 (43.65m AOD)

1 Appendix 3 - Flood Study Report for Impacts of Works at Upper Boat Substation.

2 Flood Consequence Assessment Upper Boat 275kV Substation, July 2014.

Changes to the existing model

When updating ISIS TUFLOW models instabilities can arise. This was the case with the model used for this study. To resolve the instabilities minor changes were made to the model.

These include:

- changes to the cross section widths in line with the TUFLOW model – where these didn't match previously;
- adding interpolated cross sections where the distance between the existing cross sections was too long to enable the model to carry out the hydraulic calculations; and
- smoothing the LiDAR using z-shape layers in order to remove instabilities from the 2D domain that was a result of having poor quality LiDAR data.

The ISIS TUFLOW model was run for the following events:

- 1 in 5 year return period event;
- 1 in 100 year return period event;
- 1 in 100 year return period event with climate change; and
- 1 in 1000 year return period undefended event.

Treforest Industrial Estate Topography

The site is relatively flat. Highest elevations can be found along the north western part of the site (approximately 41 m AOD). The site slopes towards the south eastern part where elevations drop to around 37 m AOD. The northern part of the site slopes west to east whereas the southern part slopes east to west. This is expected due to the location of the River Taff and the way it bisects the site.

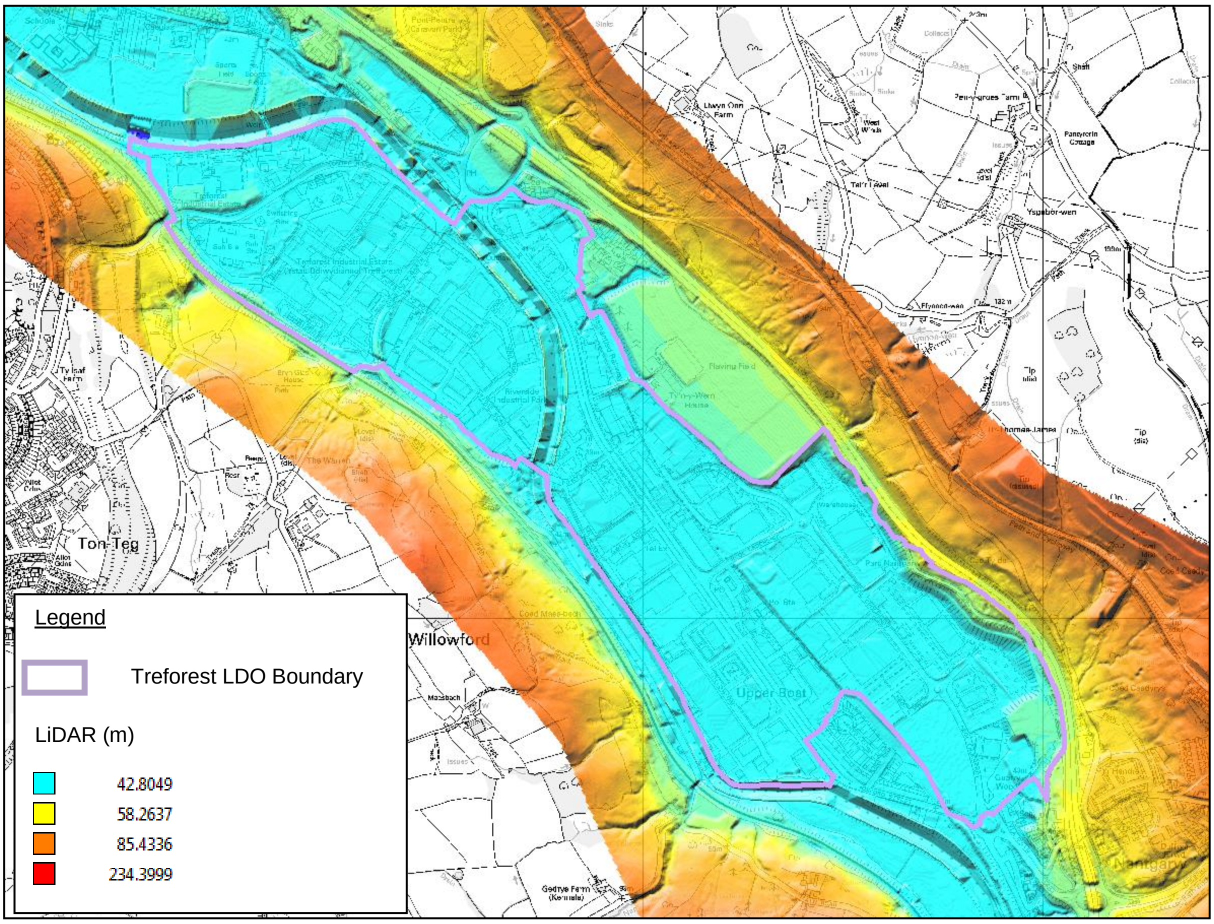


Figure 1 – Site Topography

Flooding Mechanisms

The arrows shown in Figure 2 indicate that water is generally flowing from the north western part of the site towards the south eastern following the topography of the site. Water is mainly flowing along the roads and around the building footprint. Flood waters are predicted to go out of bank in two main locations and are marked below with a blue circle.

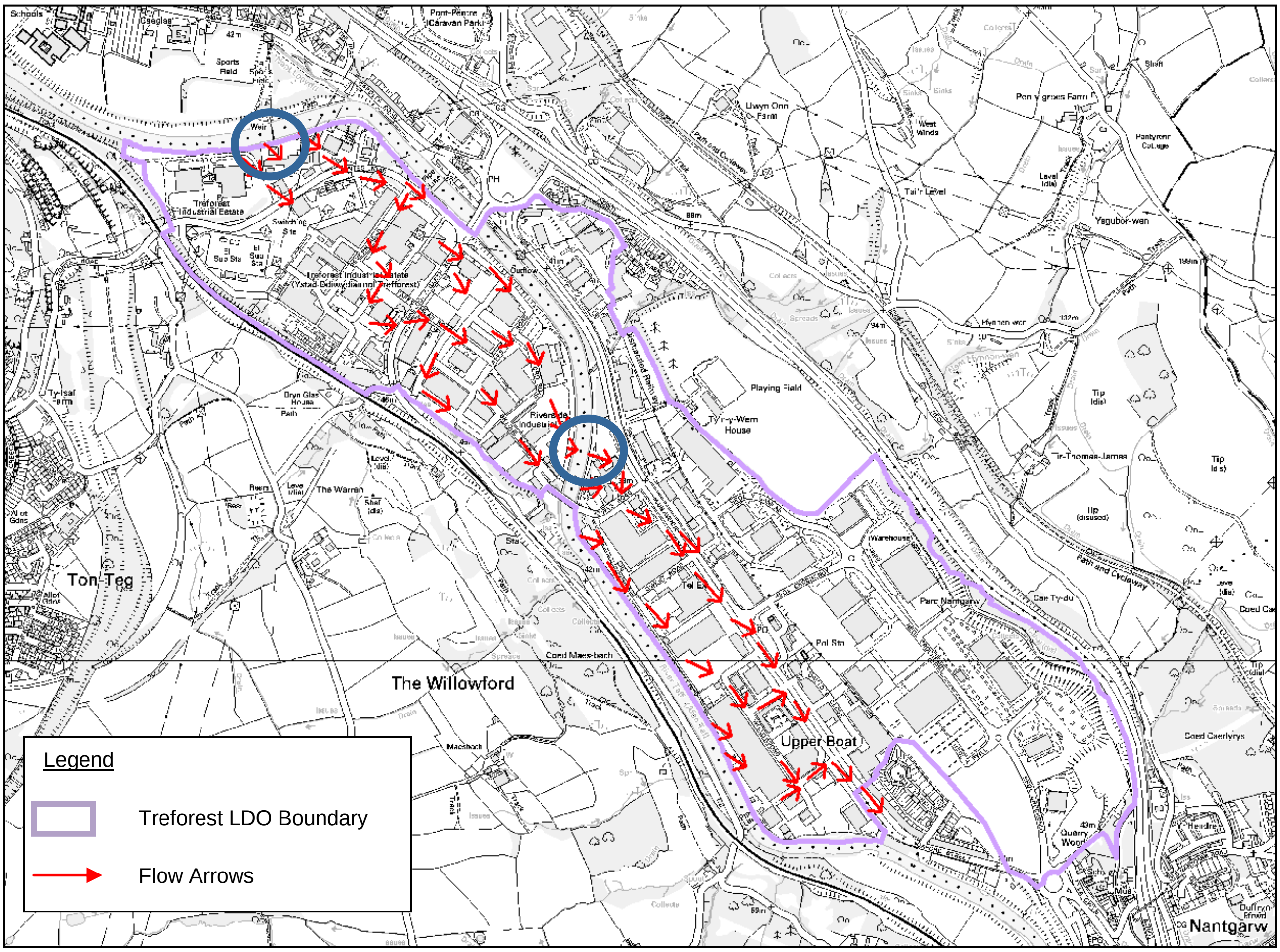


Figure 2 – Flooding Mechanisms

Scenario Testing

Three different scenarios were tested for the purpose of this study.

<u>Scenario One</u>

For scenario one all **existing** buildings that are located within the 1 in 100 year plus climate change outline were raised 300mm above the 1 in 100 year plus climate change water level (these were taken from the baseline model). In addition all of the building footprints were increased by **25%.** These buildings as shown in purple in Figure 3 below.

For the same scenario a building footprint (blue polygon) was created which raised **vacant sites** located within the 1 in 100 year plus climate change outline 300mm above the 1 in 100 climate change water level. The scenario was tested for **50%** of the **vacant sites** only.

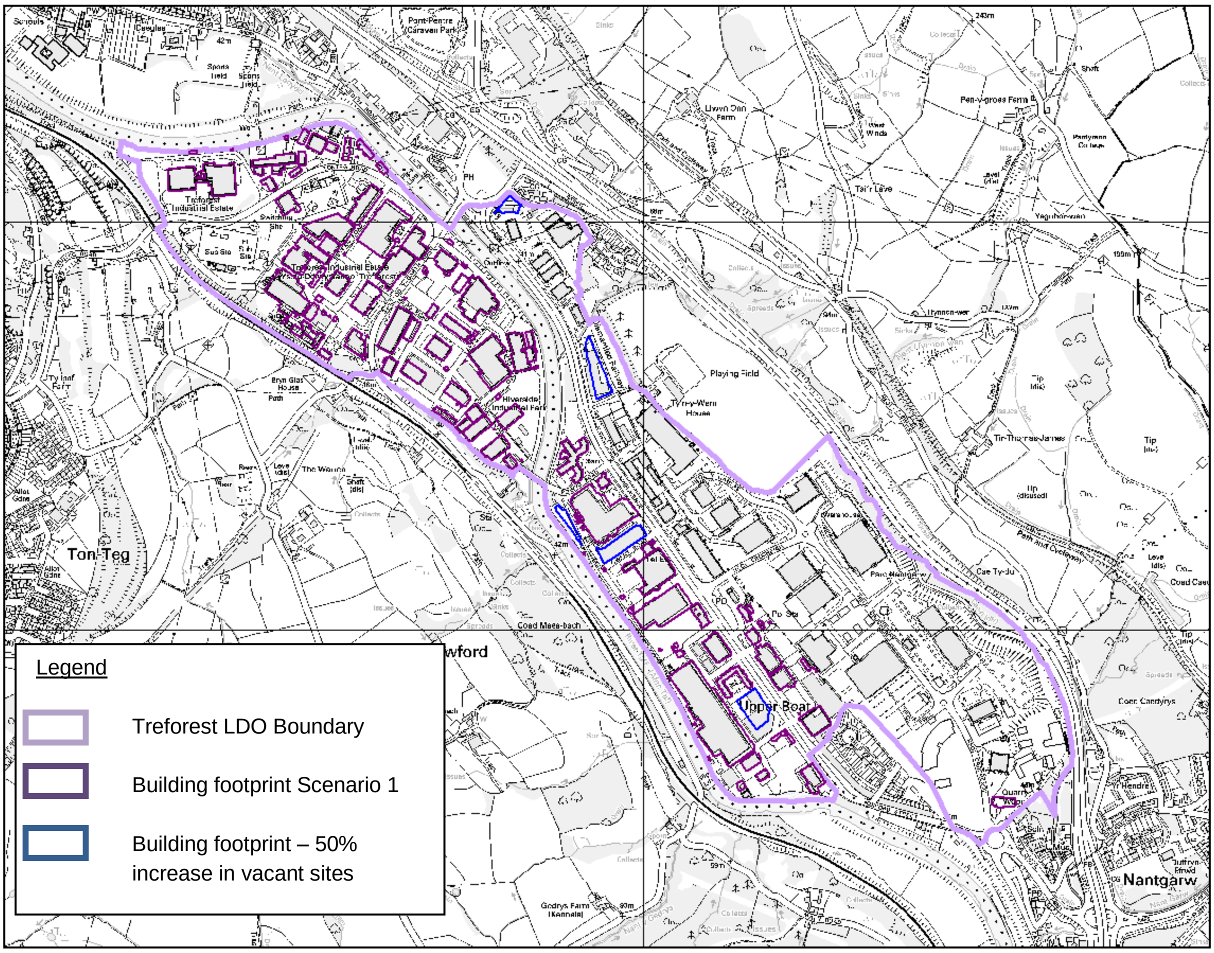


Figure 3 – Buildings changed in scenario one

Scenario Two

For scenario two all **existing** buildings that are located within the 1 in 100 year plus climate change outline were also raised 300mm above the 1 in 100 year plus climate change water level (these were taken from the baseline model). However, the building footprint was now increased by **50%** where there was enough space. These buildings as shown in pink in Figure 4 below. There are approximately two buildings where the 25% increase was used for scenario two due to space restrictions.

For the same scenario a building footprint (blue polygon) was created which raised **vacant sites** located the within the 1 in 100 year plus climate change outline 300mm above the 1 in 100 climate change water level. The scenario was tested for **50%** of the **vacant sites** only.

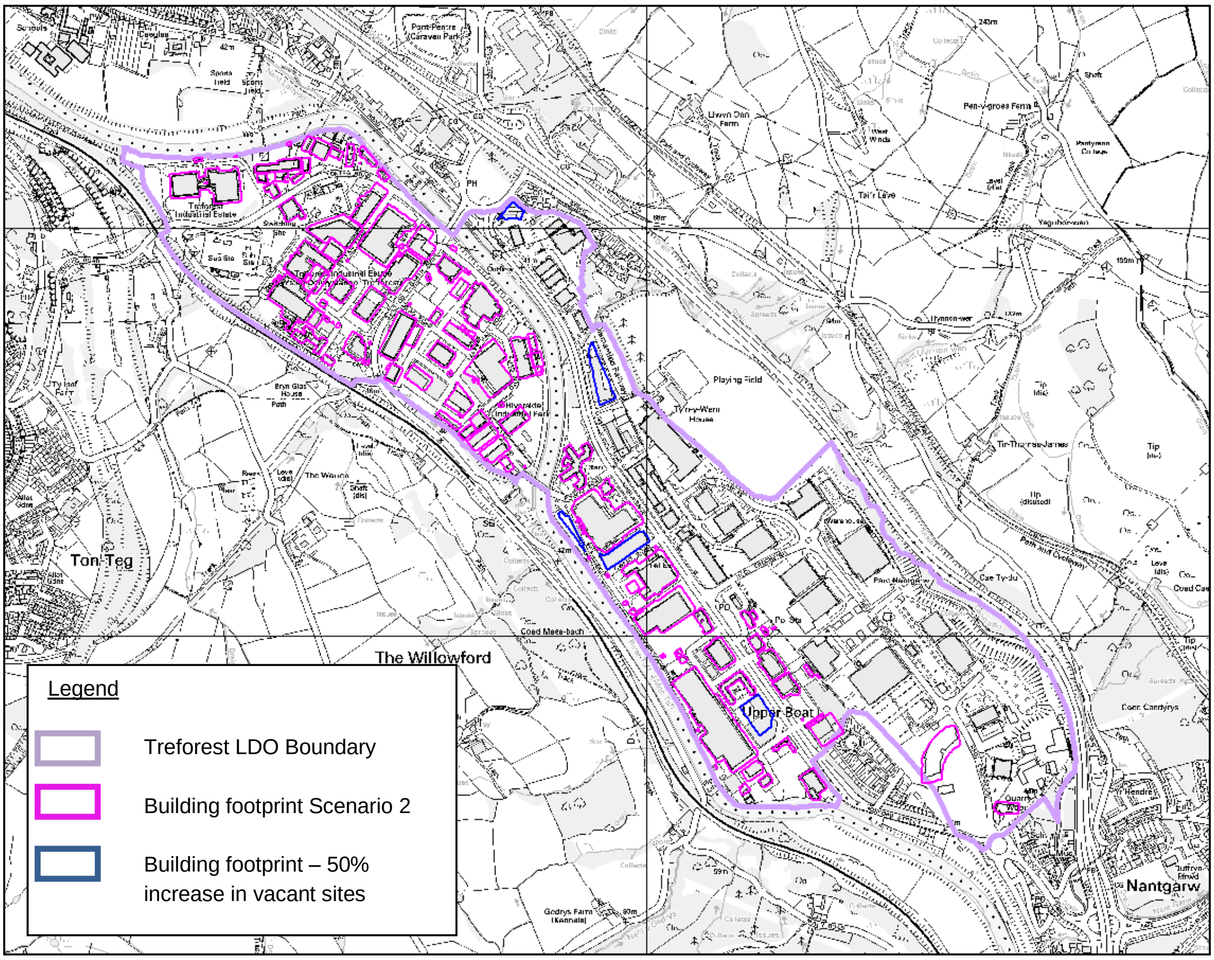


Figure 4 – Buildings changed in Scenario 2

Scenario Three

For scenario three all **existing** buildings which have a footprint **larger than 100m^2** (as agreed with RCT CBC November 2015) and are located within the 1 in 100 year plus climate change outline were raised 300mm above the 1 in 100 year plus climate change water level (these were taken from the baseline model). In addition all of the building footprints were increased by **250m^2**. These buildings are shown in light blue in Figure 5 below.

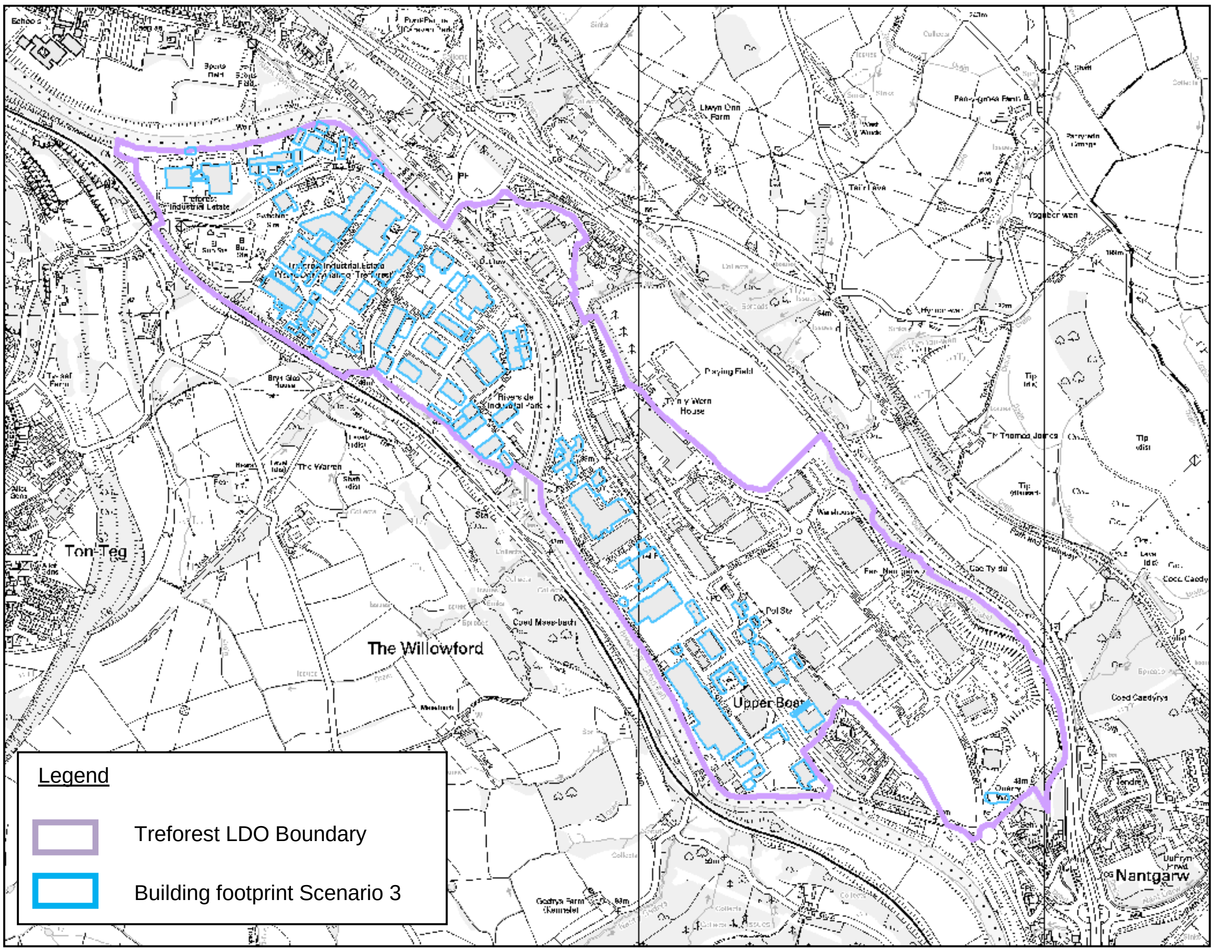


Figure 5 – Buildings changed in Scenario 3

Building levels for the baseline and all scenarios can be found in Appendix A. Existing building ground levels for scenario one range from between 36.6 and 42.8 m AOD and the resulting increase in building footprint ranges from between 0.3 and 1.9m.

Existing building ground levels for scenario two range from between 36.7 and 42.7 m AOD and the resulting building footprint rise ranges from between 0.3 and 1.5m.

Existing building ground levels for scenario three range from between 36.6 and 42.7 m AOD and the resulting building footprint rise ranges from between 0.3 and 1.5m.An average value has been used to interrogate the grids this results in a slight difference between the two scenarios.

Results

Overall, scenario one does not increase the risk of flooding within the study area for the 1 in 100 year plus climate change event. There are higher depths of flooding in the north western part of the study area (scenario one is increasing the depth of water by approximately 400mm in that area), however, there are no existing buildings located in that area. Smaller increase in water depths can be found in the middle part of the site south of Powys Road. Figure 6 below shows the difference in water depth between the baseline and scenario one. Areas shown as green suggest that the water depth for the scenario one is lower than that of the baseline. Areas marked as orange or red show that the water depths have increased for scenario one.

There is an increase in depth for scenario one within the building footprints marked with the blue circle below. Water depths have increased by approximately 150mm for the building in Location 1 and by approximately 160mm for the building in Location 2. It should be noted that the second building has not been raised as part of the scenario testing as it wasn't within the 1 in 100 year plus climate change outline. If this was raised it would probably not flood for scenario one.

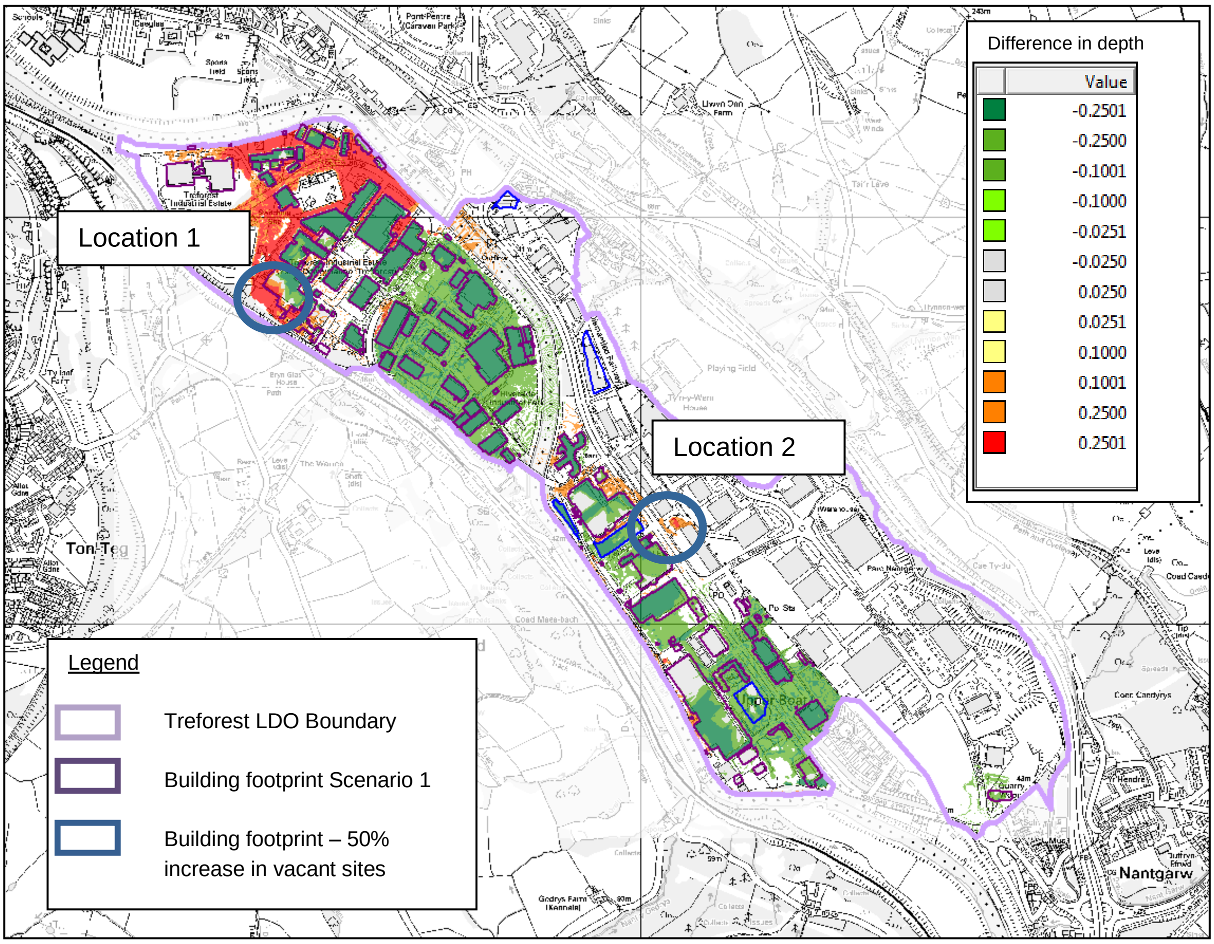


Figure 6 – Depth difference between Baseline and Scenario One – 1 in 100 year plus climate change event (difference grid scenario one minus the baseline)

The results for scenario two look similar and are shown in Figure 7 below. The difference in depth and extent are slightly bigger that these of the Scenario 1 due to the fact that the building footprints have been extended by 50% for this scenario.

Similarly to scenario one there is an increase in depth for scenario two within the building footprints marked with the blue circle below. Water depths have increased by approximately 300mm for the building in Location 1 and by approximately 300mm for the building in Location 2. It is worth mentioning that the second building has not been raised as part of the scenario testing as it wasn't within the 1 in 100 year plus climate change outline. If this was raised it would probably not flood for scenario two. Water depth has increased by approximately 150mm for the building in Location 3.

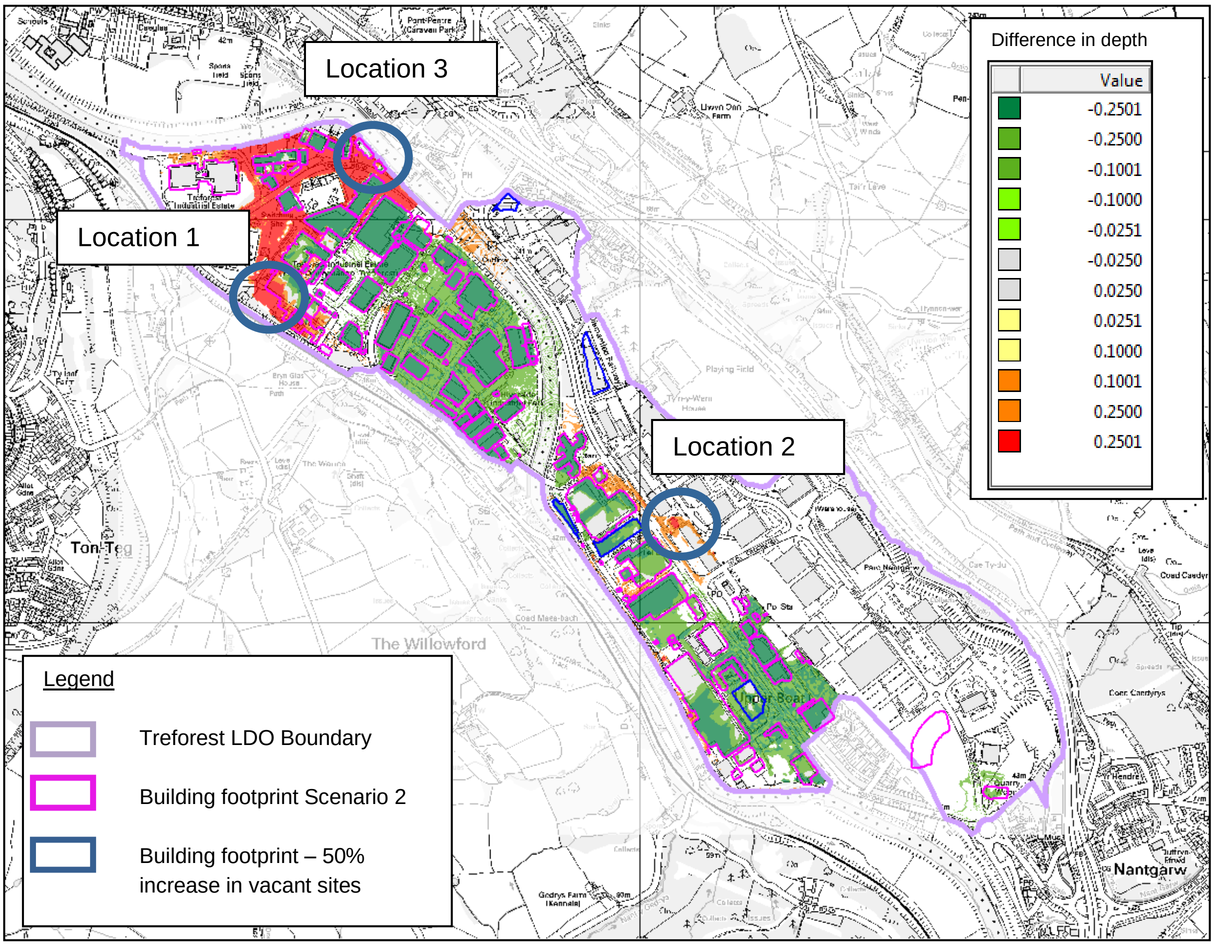


Figure 7 – Depth difference between Baseline and Scenario Two – 1 in 100 year plus climate change event (difference grid scenario two minus baseline)

The results for scenario three are similar to scenario 1 and 2 and are shown in Figure 8 below. There is a smaller difference in depth and extent when compared to Scenario 1 and Scenario 2. However, similarly to the other two scenarios, there is an increase in depth within the building footprints marked with the blue circle below. Water depths have increased by approximately 150mm for the building in Location 1, 2 and 4. It should be noted that the building in Location 2 has not been raised as part of the scenario testing as it wasn't within the 1 in 100 year plus climate change outline. If this was raised it would probably not flood for scenario three. Water depth has increased by approximately 120mm for the building in Location 3.

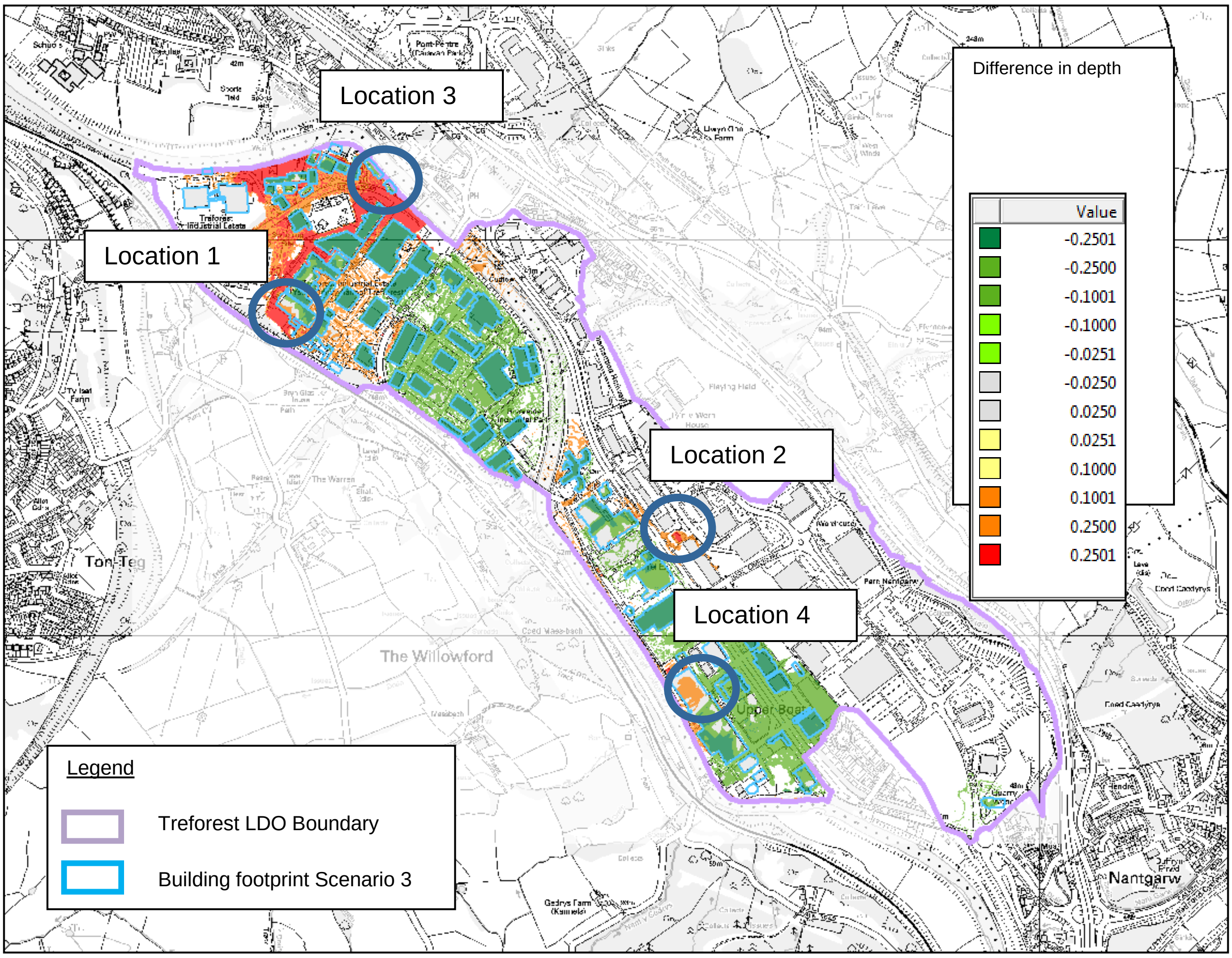


Figure 8 – Depth difference between Baseline and Scenario Three – 1 in 100 year plus climate change event (difference grid scenario three minus baseline)

Refer to Appendix B for the 1 in 100 and 1 in 1000 year return period event. Difference grids for the 1 in 5 years events show no difference therefore these are not presented in the report or the Appendix.

Actual change in water depths

The baseline and scenarios one, two and three depth grids were interrogated in a few locations to present a better idea of the actual change in water depths between the baseline and the scenarios. Figure 9 below shows the location of the points that were inspected. Table A-4 in Appendix 1 show the actual water depths reported for the baseline and scenarios one, two and 3.

The maximum increase in depth can be found around **points 5, 6 and 7** (these are marked with a blue circle in the figure below) where the water depth increases by approximately 450mm for all three scenarios. Table 1 below shows the actual water depths for the baseline and the scenarios for these 3 different points.

Table 1 – Actual water depth changes for each scenario

Point ID	1 in 100CC years (Baseline)	1 in 100CC years (Scenario one)	1 in 100CC years (Scenario two)	1 in 100CC years (Scenario three)
5	1.07	1.26	1.41	1.26
6	1.12	1.35	1.50	1.27
7	1.26	1.72	1.74	1.56

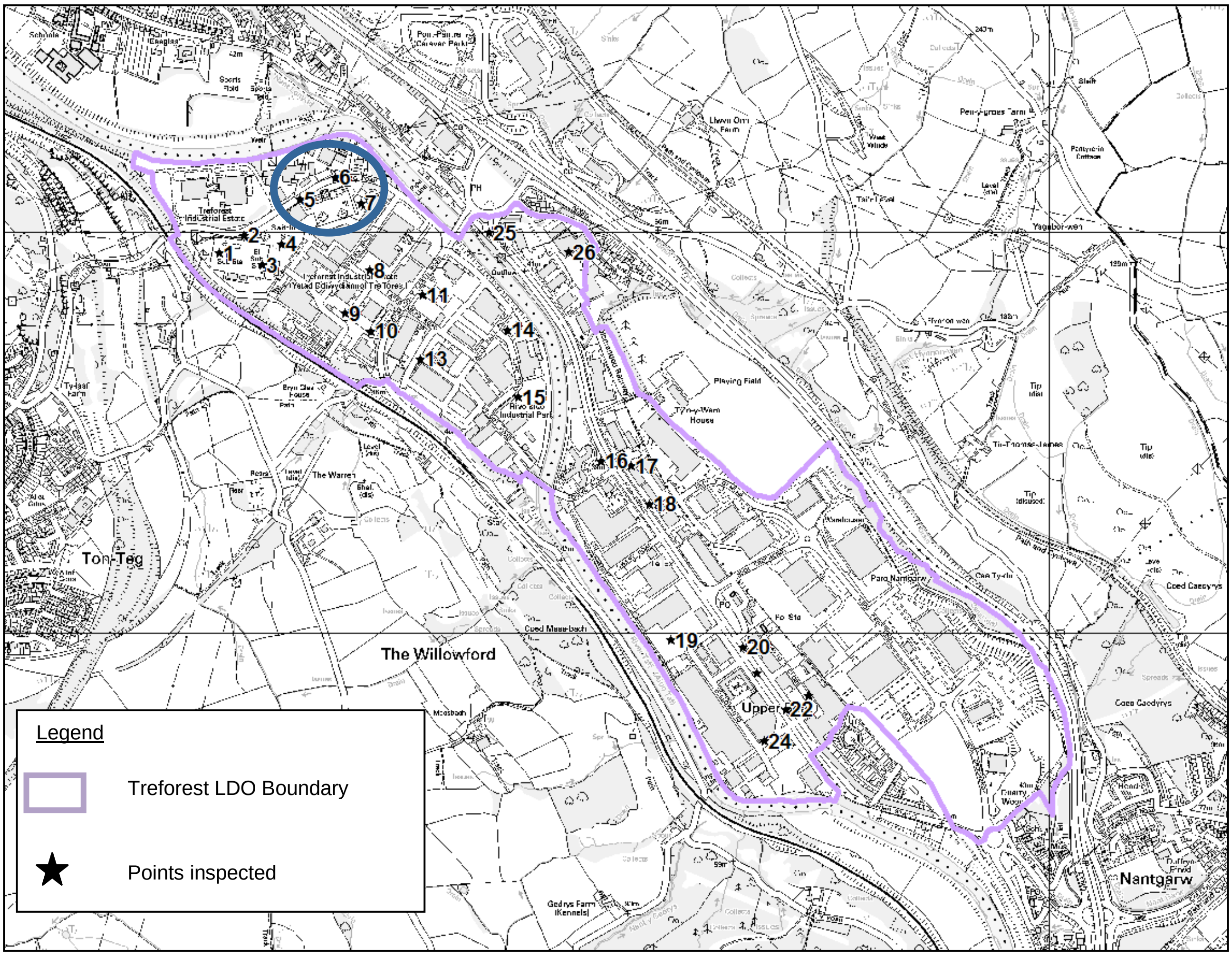


Figure 9 – Location of points inspected

Offsite Impacts

The scenarios have no impact upstream or downstream of the area of interest of events up to 1 in 100 year return period event. However, increasing the building footprint and raising the building (300mm above the 1 in 100 year plus climate change water level) within the study area slightly changes the flood risk upstream and downstream of the area of interest for larger events. Figure 10 below shows that the areas affected for the 1 in 100 plus climate change year event. These areas are mostly within the river banks and within parts of undeveloped floodplain. There are approximately two buildings affected upstream (Location 1) where the depth increases by approximately 150mm and another two buildings downstream of the study area (Location 2) where the water depths increase approximately by 300mm. There are no buildings affected within Location 3. Results are similar for scenarios two and three as well. The relevant figures can be found in Appendix B.

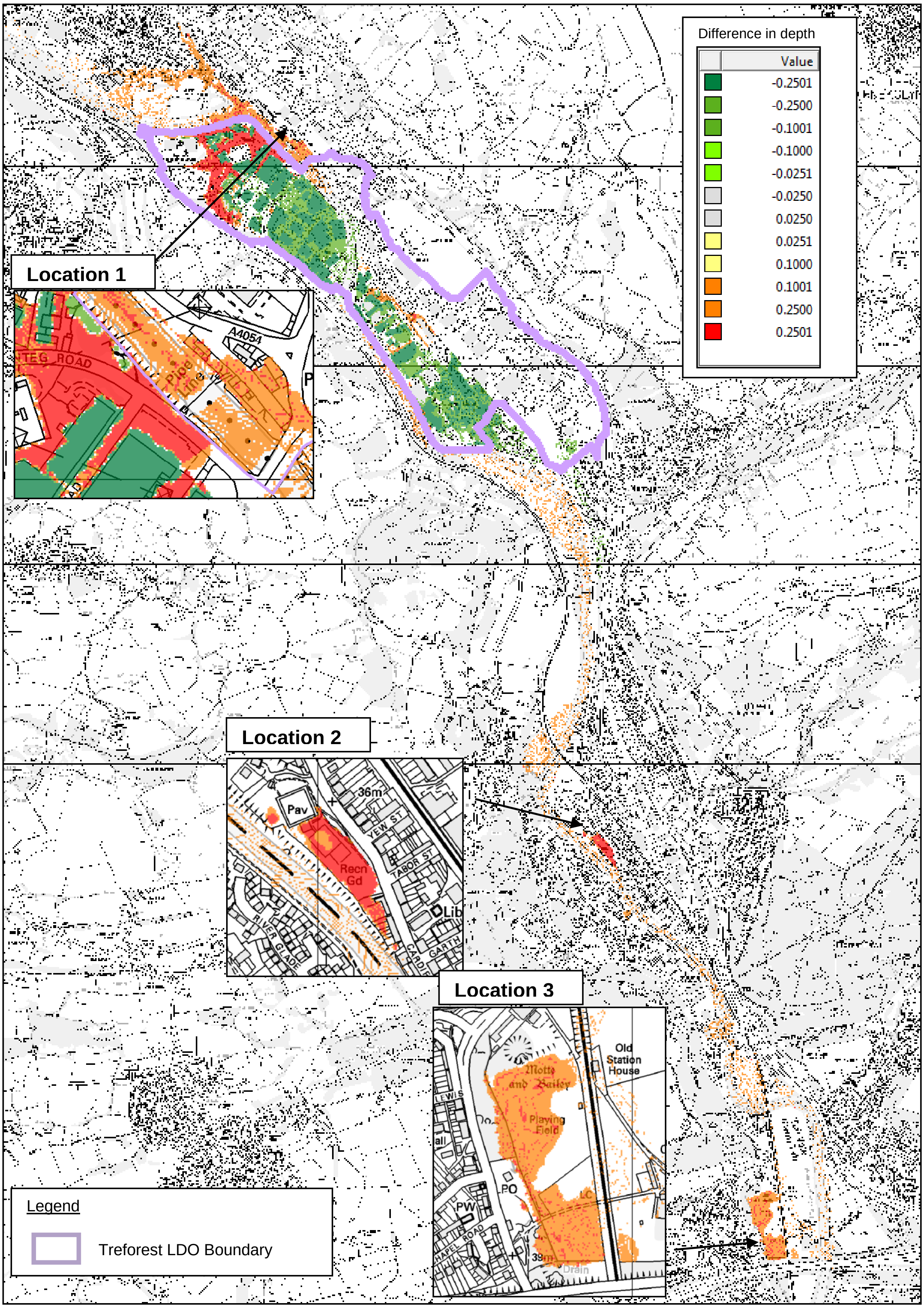


Figure 10 – Depth difference between Baseline and Scenario One – 1 in 100 year plus climate change event (difference grid scenario one minus baseline)

Development Zones and Flood Consequences Assessment Requirements

Based on the above results **indicative** development zones were produced within the study area. These zones are clipped to the roads and are presented in Figure 11 below.

- **Red Zone**--If any development is to take place within this zone a TAN15 compliant Flood Consequences (FCA) will be required.
- **Orange Zone**--Flood risk in the orange zone is dependent on changes made in the red zone further upstream. Any further development within the orange zone is unlikely to cause any change in water depths. However, if new development has already taken place in the zones further upstream, any additional development within the orange zone (especially within the areas marked with the blue circles in the sections above) is suggested to have an individual FCA.
- **Green Zone**--There is no increase in water depths within the green zones. There is lower depth of water in these areas for the scenarios than there is for the baseline. Therefore, there is no restriction on development here.
- **Blue Zone**--there is no predicted flooding for the baseline and also for scenarios one, two and three.

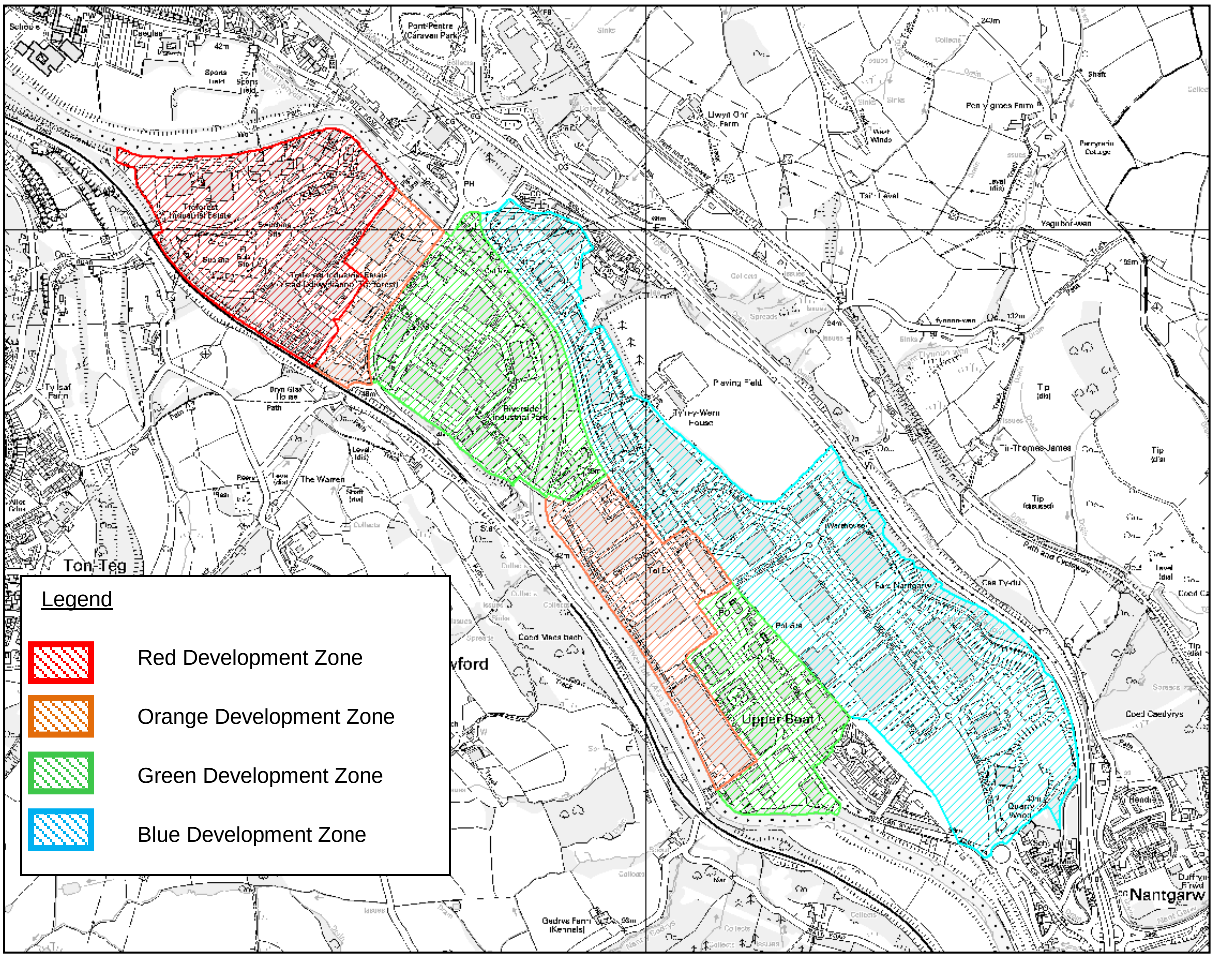


Figure 11 – Indicative Development Zones

Summary

The purpose of this study is to enable Rhondda Cynon Taf County Borough Council to identify the development classes that would be permitted by the Local Development Order within the Treforest Industrial area.

Three different development scenarios were run to assess the potential impacts that new development will have in the area. The scenarios produced similar results when compared to the baseline.

Findings of this study are summarised below:

- Overall, the scenarios do not increase the risk of flooding within the study area for the 1 in 100 year plus climate change event.
- There are higher depths of flooding in the north western part of the study area, however, there are no existing buildings located in that area.
- Smaller increase in water depths can be found in the middle part of the site south of Powys Road.
- There is an impact on flood risk upstream and downstream of the area of interest as a result of the scenarios run. The areas potentially impacted for the 1 in 100 plus climate change year event are mostly within the river banks and within parts of the undeveloped floodplain. There are approximately two buildings affected upstream where the depth increases by approximately 150mm and another two buildings downstream of the study area where the water depths increase approximately by 300mm.
- Four different development zones were created as part of this analysis. It is suggested that any development in the red zone will require and FCA. Individual FCAs might be required for development within the orange zone. Due to the flooding mechanisms, flood risk in that zone is depended on changes that occur in the red zone further upstream.

Appendix A

Table A-1 - Building elevations with 25% increase in footprint

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
1	37.09	36.65	0.44
2	37.85	37.50	0.35
3	37.78	37.43	0.35
4	37.73	37.21	0.53
5	37.85	37.46	0.38
6	38.17	37.80	0.37
7	37.75	36.88	0.86
8	38.40	37.74	0.65
9	37.74	36.79	0.96
10	37.85	37.42	0.43
11	37.74	37.09	0.65
12	37.74	37.34	0.40
13	37.75	37.01	0.73
14	37.77	37.08	0.69
15	38.53	37.98	0.55
16	37.74	37.25	0.50
17	38.13	37.70	0.43
18	38.14	37.48	0.65
19	38.15	37.72	0.43
20	38.14	37.63	0.50
21	37.75	36.90	0.85
22	38.13	37.61	0.52
23	38.04	37.69	0.35
24	37.75	36.98	0.77
25	37.75	37.09	0.65
26	37.75	37.10	0.65
27	37.75	37.32	0.43
28	38.34	37.77	0.57
29	38.37	37.75	0.62
30	37.75	37.39	0.36
31	38.11	37.65	0.46
32	38.51	37.86	0.65
33	38.33	37.62	0.71
34	38.61	37.98	0.63
35	39.27	37.30	1.97
36	38.64	38.12	0.52
37	38.66	38.04	0.62
38	38.67	38.09	0.59
39	39.42	38.84	0.58
40	39.42	38.77	0.65
41	39.43	38.92	0.50
42	39.43	38.87	0.55
43	39.44	39.01	0.43

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
44	39.47	39.02	0.45
45	39.47	38.92	0.55
46	39.47	38.93	0.54
47	39.87	39.33	0.54
48	39.53	39.07	0.47
49	40.20	39.09	1.11
50	40.22	39.41	0.81
51	40.02	39.28	0.74
52	40.26	39.38	0.88
53	40.24	39.21	1.03
54	40.38	39.40	0.98
55	40.33	39.40	0.93
56	40.39	39.36	1.03
57	40.37	39.11	1.26
58	40.38	39.23	1.14
59	40.36	39.42	0.93
60	40.38	39.12	1.26
61	40.37	39.24	1.12
62	40.42	39.36	1.06
63	40.40	39.14	1.26
64	40.40	39.22	1.18
65	40.44	39.38	1.06
66	40.36	39.11	1.25
67	40.48	39.49	0.98
68	40.43	39.17	1.26
69	40.48	39.51	0.97
70	40.48	39.80	0.69
71	40.48	39.52	0.96
72	41.11	40.12	0.99
73	40.40	39.78	0.62
74	41.11	40.76	0.35
75	40.41	39.36	1.05
76	40.50	39.36	1.14
77	40.47	39.27	1.21
78	41.10	39.90	1.20
79	40.46	39.27	1.19
80	40.42	39.41	1.01
81	40.48	39.26	1.22
82	41.11	39.99	1.12
83	41.13	40.72	0.40
84	40.49	39.32	1.17
85	41.11	40.17	0.95
86	41.11	40.46	0.65
87	40.53	39.26	1.27
88	41.14	40.73	0.40
89	41.12	40.45	0.67

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
90	40.67	39.60	1.07
91	40.53	39.27	1.27
92	41.15	40.56	0.59
93	40.74	39.05	1.68
94	41.15	40.38	0.77
95	41.14	40.09	1.05
96	40.54	39.40	1.14
97	40.55	39.74	0.81
98	41.16	40.16	1.01
99	41.24	40.61	0.63
100	41.24	40.72	0.52
101	41.17	40.53	0.64
102	40.74	39.78	0.96
103	41.17	40.18	0.99
104	40.57	39.76	0.82
105	41.15	39.89	1.26
106	41.16	40.40	0.76
107	41.30	40.64	0.65
108	40.76	39.95	0.81
109	41.15	40.17	0.98
110	40.61	39.92	0.68
111	41.16	39.63	1.52
112	41.51	40.75	0.75
113	41.38	40.67	0.71
114	41.16	39.94	1.22
115	41.62	40.69	0.93
116	41.45	39.91	1.54
117	41.91	40.51	1.40
118	41.56	40.46	1.10
119	42.19	41.40	0.79
120	41.88	41.35	0.53
121	42.55	41.35	1.20
122	41.87	41.27	0.60
123	43.15	42.80	0.36
124	42.32	41.68	0.64
125	41.65	41.22	0.43
126	41.70	40.52	1.18
127	42.55	41.55	1.00
128	42.12	40.99	1.13
129	43.20	42.30	0.90
130	43.16	42.31	0.84
131	41.82	40.94	0.88
132	41.72	41.23	0.49
133	41.81	40.99	0.83
134	42.19	41.45	0.75
135	42.02	41.13	0.89

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
136	42.18	41.50	0.68
137	37.74	36.90	0.84
138	39.52	38.23	1.29
139	38.81	38.20	0.61
140	37.75	37.24	0.51

Refer to Figure below for the location of each building.

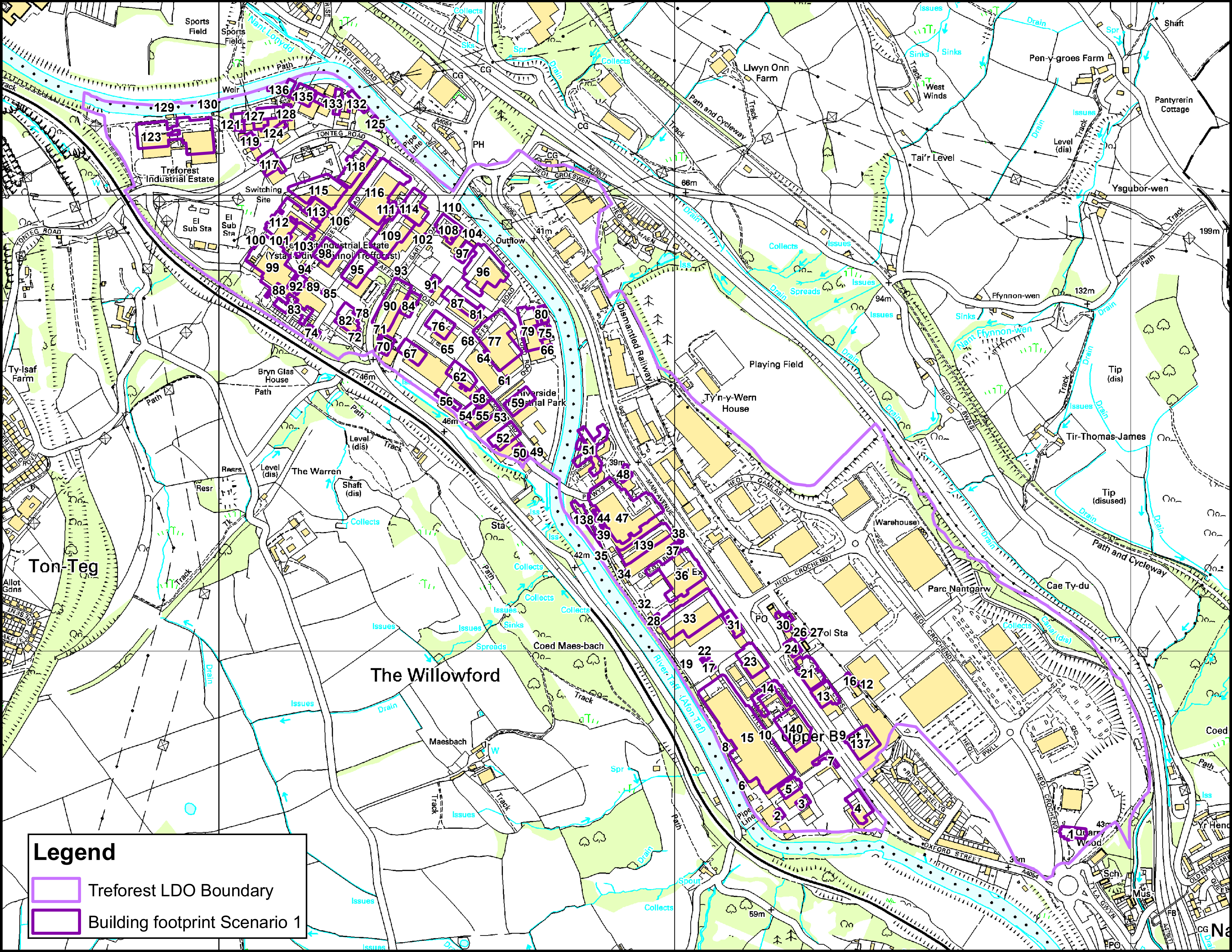

Legend
Treforest LDO Boundary
Building footprint Scenario 1
Sports Field
Nant Lonydd
Weir
Treforest Industrial Estate
Switching Site
El Sub Sta
Industrial Estate (Ystad Ddiwydiannol Trefforest)
Tonteg Road
Cardiff Road
PH
Outflow
Heol Groeswen
Dismantled Railway
Playing Field
Ty'n-y-Wern House
Llwyn Onn Farm
Path and Cycleway
West Winds
Pen-y-groes Farm
Pantyrerin Cottage
Tai'r Level
Ysgubor-wen
Ffynnon-wen
Nant Ffynnon-wen
Tip (dis)
Tir-Thomas-James
Tip (disused)
Cae Ty-du
Warehouse
Parc Nantgarw
Riverside Industrial Park
Bryn Glas House
Ty-Isaf Farm
Ton-Teg
The Warren
Shaft (dis)
Level (dis)
Coed Maes-bach
The Willowford
Maesbach
River Taff (Afon Taf)
Heol y Gamlas
Heol Crochendy
Main Avenue
Upper Boat
Oxford Street
Quarry Wood
Canal (dis)
Allot Gdns
Sch
Mus

Table A-2 - Building elevations with 50% increase in footprint.

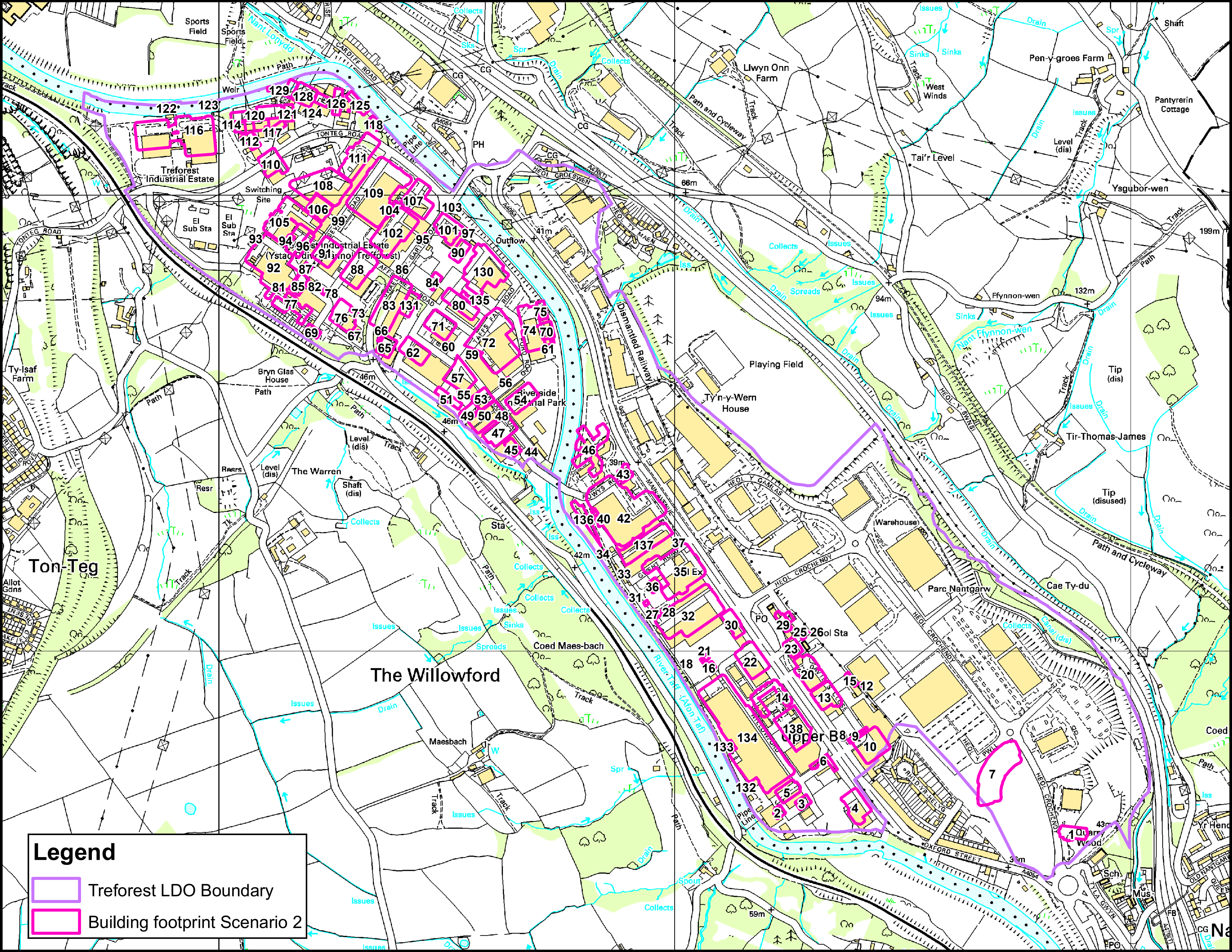
Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
1	37.09	36.65	0.43
2	37.85	37.48	0.37
3	37.78	37.43	0.35
4	37.73	37.20	0.53
5	37.85	37.45	0.40
6	37.75	37.00	0.75
7	37.10	36.75	0.35
8	37.74	36.79	0.96
9	37.74	36.79	0.95
10	37.74	36.93	0.81
11	37.74	37.24	0.50
12	37.74	37.29	0.45
13	37.75	37.00	0.75
14	37.77	37.07	0.70
15	37.74	37.24	0.50
16	38.13	37.70	0.43
17	38.14	37.51	0.62
18	38.15	37.72	0.43
19	38.14	37.63	0.50
20	37.75	36.89	0.86
21	38.13	37.62	0.52
22	38.04	37.69	0.35
23	37.75	36.99	0.76
24	37.75	37.09	0.65
25	37.75	37.10	0.65
26	37.75	37.36	0.39
27	38.45	37.95	0.50
28	38.33	37.80	0.53
29	37.75	37.39	0.36
30	38.12	37.66	0.46
31	38.51	37.87	0.64
32	38.34	37.63	0.71
33	38.62	37.96	0.65
34	39.27	38.58	0.68
35	38.65	38.08	0.57
36	38.56	37.93	0.63
37	38.68	38.09	0.59
38	39.42	39.07	0.35
39	39.43	38.92	0.50
40	39.46	38.99	0.47
41	39.47	38.99	0.48
42	39.87	39.32	0.55
43	39.54	39.06	0.47
44	40.20	39.09	1.11
45	40.18	39.26	0.92

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
46	40.02	39.29	0.73
47	40.26	39.34	0.92
48	40.24	39.21	1.03
49	40.38	39.41	0.96
50	40.32	39.34	0.98
51	40.39	39.26	1.13
52	40.37	39.01	1.36
53	40.37	39.25	1.13
54	40.36	39.41	0.94
55	40.37	38.96	1.41
56	40.37	39.27	1.10
57	40.42	39.29	1.13
58	40.41	39.30	1.11
59	40.41	39.30	1.11
60	40.44	39.35	1.10
61	40.36	39.22	1.14
62	40.48	39.51	0.97
63	40.41	39.30	1.11
64	40.48	39.57	0.92
65	40.48	39.78	0.70
66	40.48	39.67	0.81
67	41.11	40.03	1.08
68	40.36	39.75	0.61
69	41.11	40.76	0.35
70	40.41	39.62	0.79
71	40.50	39.34	1.17
72	40.47	39.27	1.20
73	41.10	39.94	1.16
74	40.46	39.28	1.19
75	40.42	39.60	0.81
76	41.11	40.05	1.06
77	41.14	40.73	0.40
78	41.11	40.16	0.95
79	41.11	40.46	0.65
80	40.53	39.28	1.25
81	41.14	40.73	0.40
82	41.12	40.44	0.68
83	40.69	39.64	1.05
84	40.53	39.29	1.25
85	41.15	40.54	0.60
86	40.74	39.44	1.30
87	41.15	40.42	0.73
88	41.14	40.08	1.06
89	41.25	40.90	0.35
90	40.55	39.75	0.80
91	41.16	40.16	1.01

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
92	41.24	40.60	0.64
93	41.25	40.81	0.44
94	41.17	40.45	0.72
95	40.74	39.79	0.95
96	41.17	40.17	1.00
97	40.57	39.76	0.81
98	41.15	39.89	1.26
99	41.16	40.40	0.76
100	41.30	40.72	0.58
101	40.77	39.94	0.84
102	41.15	40.14	1.02
103	40.61	39.91	0.69
104	41.16	39.68	1.48
105	41.51	40.75	0.76
106	41.38	40.64	0.74
107	41.16	40.13	1.03
108	41.62	40.66	0.96
109	41.45	39.91	1.53
110	41.91	40.60	1.32
111	41.56	40.43	1.13
112	42.19	41.40	0.80
113	41.86	41.21	0.65
114	42.55	41.44	1.11
115	41.89	41.34	0.56
116	43.15	42.79	0.36
117	42.32	41.70	0.62
118	41.66	41.12	0.54
119	41.70	40.52	1.18
120	42.55	41.51	1.05
121	42.12	41.01	1.11
122	43.19	42.51	0.68
123	43.16	42.65	0.50
124	41.82	40.95	0.87
125	41.71	41.17	0.54
126	41.82	40.99	0.83
127	42.19	41.44	0.75
128	42.02	41.14	0.88
129	42.17	41.48	0.68
130	40.54	39.40	1.14
131	40.49	39.33	1.17
132	37.87	37.42	0.45
133	38.40	37.74	0.65
134	38.53	37.98	0.55
135	40.50	39.19	1.31
136	39.52	38.23	1.29
137	38.81	38.20	0.61

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
138	37.75	37.24	0.51

Refer to Figure below for the location of each building.



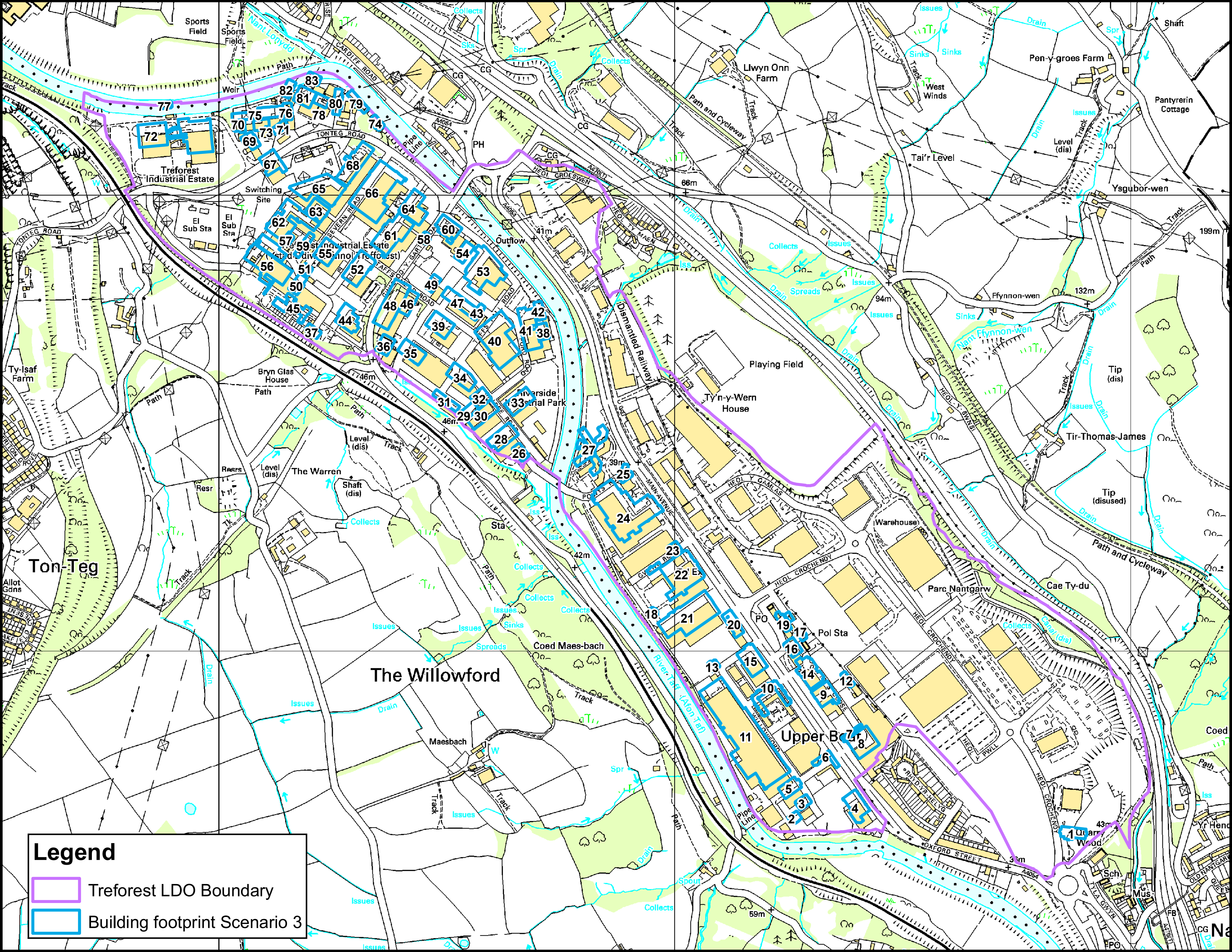
Legend
Treforest LDO Boundary
Building footprint Scenario 2
Treforest Industrial Estate
Ton-Teg
The Willowford
Parc Nantgarw
Playing Field
Ty'n-y-Wern House
Coed Maes-bach
Llwyn Onn Farm
Pen-y-groes Farm
Ysgubor-wen
Tir-Thomas-James
Ffynnon-wen
Cae Ty-du
Ty-Isaf Farm
Bryn Glas House
Maesbach
Riverside Industrial Park
Dismantled Railway
Path and Cycleway
River Taff (Afon Taf)

Table A-3 - Building elevations with 250m^2 increase in footprint.

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
1	37.09	36.62	0.47
2	37.80	37.42	0.38
3	37.77	37.38	0.38
4	37.71	37.16	0.55
5	37.80	37.39	0.41
6	37.74	36.85	0.89
7	37.74	36.61	1.13
8	37.74	36.89	0.85
9	37.74	36.99	0.76
10	37.75	37.03	0.72
11	38.09	37.52	0.57
12	37.74	37.26	0.48
13	38.10	37.64	0.46
14	37.75	36.87	0.88
15	37.84	37.46	0.38
16	37.75	36.95	0.79
17	37.75	37.08	0.67
18	38.43	37.91	0.52
19	37.75	37.36	0.39
20	38.02	37.53	0.49
21	38.24	37.46	0.77
22	38.53	37.99	0.54
23	38.63	37.99	0.65
24	39.39	38.82	0.57
25	39.49	38.99	0.50
26	40.11	39.28	0.83
27	39.94	39.17	0.77
28	40.17	39.28	0.89
29	40.34	39.33	1.01
30	40.28	39.34	0.94
31	40.37	39.35	1.03
32	40.36	39.19	1.17
33	40.27	39.31	0.96
34	40.39	39.30	1.09
35	40.43	39.42	1.01
36	40.47	39.75	0.72
37	41.12	40.74	0.38
38	40.39	39.28	1.11
39	40.47	39.31	1.16
40	40.42	39.18	1.23
41	40.41	39.19	1.22
42	40.42	39.47	0.95
43	40.47	39.21	1.27
44	41.12	39.97	1.15
45	41.12	40.70	0.43

Building ID	Building elevation (mAOD) – post raising	LiDAR (mAOD)	Difference
46	40.49	39.31	1.18
47	40.49	39.20	1.30
48	40.55	39.45	1.10
49	40.53	39.24	1.29
50	41.14	40.51	0.63
51	41.14	40.32	0.82
52	41.08	40.00	1.08
53	40.51	39.33	1.18
54	40.55	39.71	0.84
55	41.15	40.11	1.03
56	41.18	40.53	0.65
57	41.18	40.43	0.75
58	40.71	39.71	1.00
59	41.17	40.14	1.03
60	40.62	39.79	0.83
61	41.00	40.00	1.00
62	41.29	40.51	0.78
63	41.29	40.56	0.74
64	40.97	39.72	1.25
65	41.49	40.53	0.96
66	41.24	39.67	1.57
67	41.69	40.31	1.38
68	41.50	40.36	1.14
69	41.91	41.08	0.82
70	42.35	41.13	1.22
71	41.68	41.04	0.63
72	43.08	42.70	0.38
73	42.04	41.41	0.63
74	41.50	41.01	0.49
75	42.26	41.21	1.04
76	41.88	40.67	1.21
77	43.18	42.35	0.83
78	41.64	40.65	0.99
79	41.61	41.09	0.52
80	41.63	40.77	0.86
81	41.74	40.74	1.00
82	42.09	41.31	0.78
83	42.01	41.63	0.38

Refer to Figure below for the location of each building.



Legend
Treforest LDO Boundary
Building footprint Scenario 3
Treforest Industrial Estate
Riverside Industrial Park
Parc Nantgarw
Upper Boat
The Willowford
Ton-Teg
Playing Field
Ty'n-y-Wern House
Llwyn Onn Farm
Pen-y-groes Farm
Pantyrerin Cottage
Ysgubor-wen
Tai'r Level
Ffynnon-wen
Tir-Thomas-James
Cae Ty-du
Coed Maes-bach
Bryn Glas House
The Warren
Maesbach
Ty-Isaf Farm
Sports Field
Switching Site
Dismantled Railway
Path and Cycleway
River Taff (Afon Taf)
Nant Ffynnon-wen
Warehouse
Pol Sta
Quarry Wood
TONTEG ROAD
CARDIFF ROAD
SEVERN ROAD
MAIN AVENUE
HEOL Y GAMLAS
HEOL CROCHENDY
HEOL Y SWAN
HEOL GROESWEN
OXFORD STREET

Table A-4 – Actual water depths for Baseline and Scenarios 1, 2 & 3.

Point ID	1 in 100 years (baseline)	1 in 100 years (scenario one)	1 in 100 years (scenario two)	1 in 100 years (scenario three)	1 in 100CC years (baseline)	1 in 100CC years (scenario one)	1 in 100CC years (scenario two)	1 in 100CC years (scenario three)	1 in 1000 years (baseline)	1 in 1000years (scenario one)	1 in 1000 years (scenario two)	1 in 1000 years (scenario three)
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.81	0.96	0.81
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.18	0.00	0.35	0.66	0.79	0.51	1.11	1.41	1.54	1.39
5	0.47	0.66	0.81	0.51	1.07	1.26	1.41	1.26	1.87	2.17	2.29	2.17
6	0.51	0.75	0.90	0.66	1.12	1.35	1.50	1.27	1.87	2.26	2.33	2.18
7	0.66	1.11	1.26	0.96	1.26	1.72	1.74	1.56	2.02	2.47	2.49	2.32
8	0.35	0.56	0.51	0.51	0.81	0.81	0.81	0.93	1.72	2.07	2.17	2.02
9	0.23	0.48	0.38	0.38	0.78	0.78	0.69	0.83	1.69	2.04	2.05	1.99
10	0.25	0.53	0.46	0.46	0.81	0.81	0.70	0.85	1.72	2.06	2.06	1.97
11	0.23	0.24	0.24	0.24	0.53	0.39	0.39	0.53	1.44	1.90	2.05	1.89
12	0.20	0.20	0.20	0.20	0.51	0.35	0.35	0.35	1.59	2.02	2.17	2.02
13	0.67	0.81	0.81	0.81	1.26	0.97	1.11	1.11	2.32	2.77	2.77	2.62
14	0.46	0.51	0.51	0.51	0.96	0.81	0.81	0.84	2.02	2.43	2.47	2.32
15	0.35	0.35	0.35	0.35	0.81	0.66	0.66	0.66	1.72	2.32	2.32	2.17
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	1.11	1.26	0.96
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	1.13	1.24	0.96
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	1.23	1.26	1.09
19	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	1.25	1.26	1.26	1.26
20	0.00	0.00	0.00	0.00	0.36	0.20	0.09	0.20	1.57	1.60	1.60	1.57
21	0.00	0.00	0.00	0.00	0.81	0.57	0.51	0.66	1.93	1.93	1.93	1.93
22	0.00	0.00	0.00	0.00	0.93	0.66	0.66	0.66	2.02	2.02	2.02	2.02
23	0.00	0.00	0.00	0.00	0.71	0.51	0.51	0.56	1.85	1.85	1.84	1.85
24	0.00	0.00	0.00	0.00	0.42	0.21	0.11	0.27	1.48	1.48	1.48	1.48
25	0.55	0.55	0.55	0.55	0.00	0.00	0.00	0.00	0.14	0.51	0.60	0.45
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.66	0.51

Appendix B

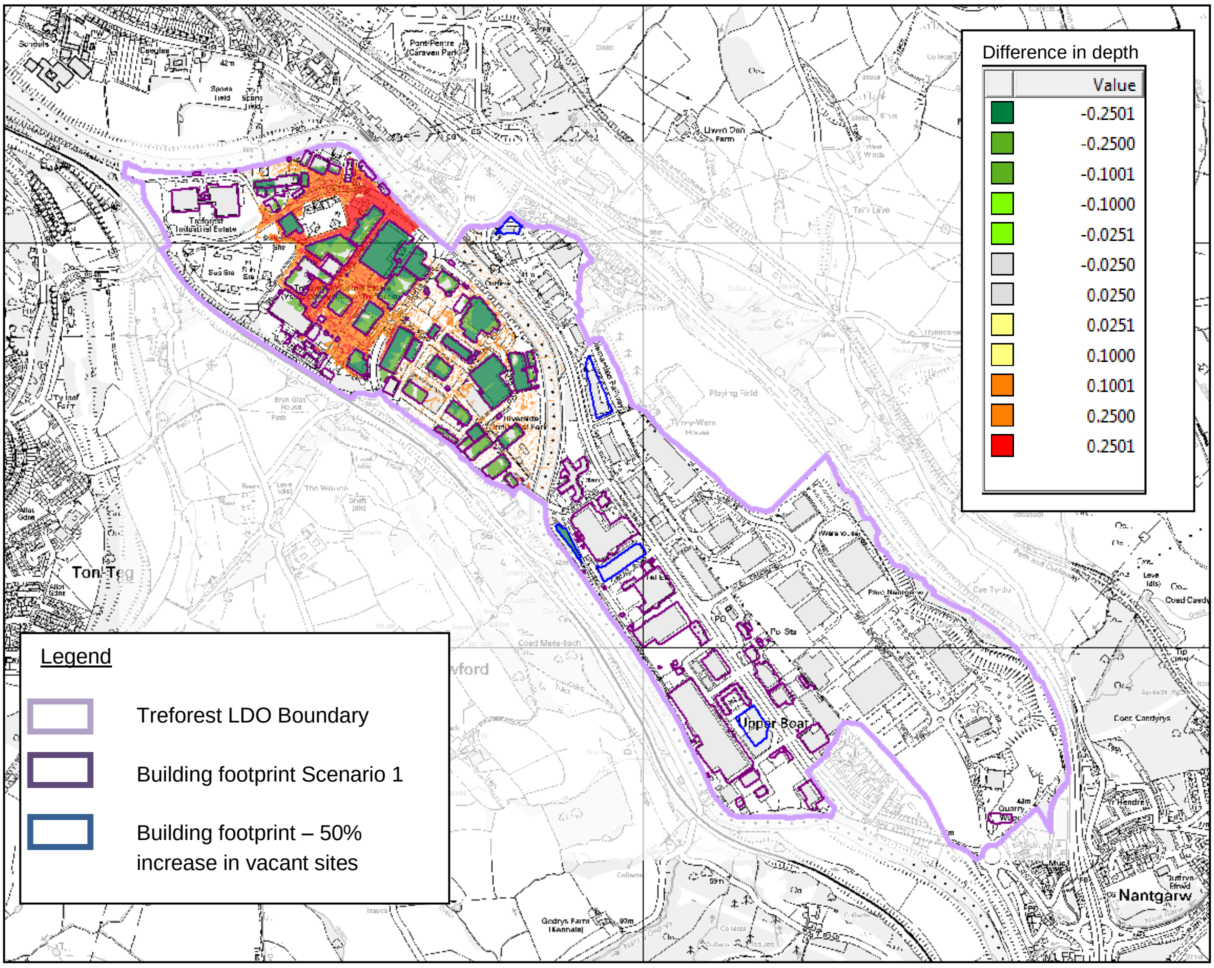


Figure B - 1 – Depth difference between Baseline and Scenario One – 1 in 100 year event (difference grid scenario one minus the baseline)

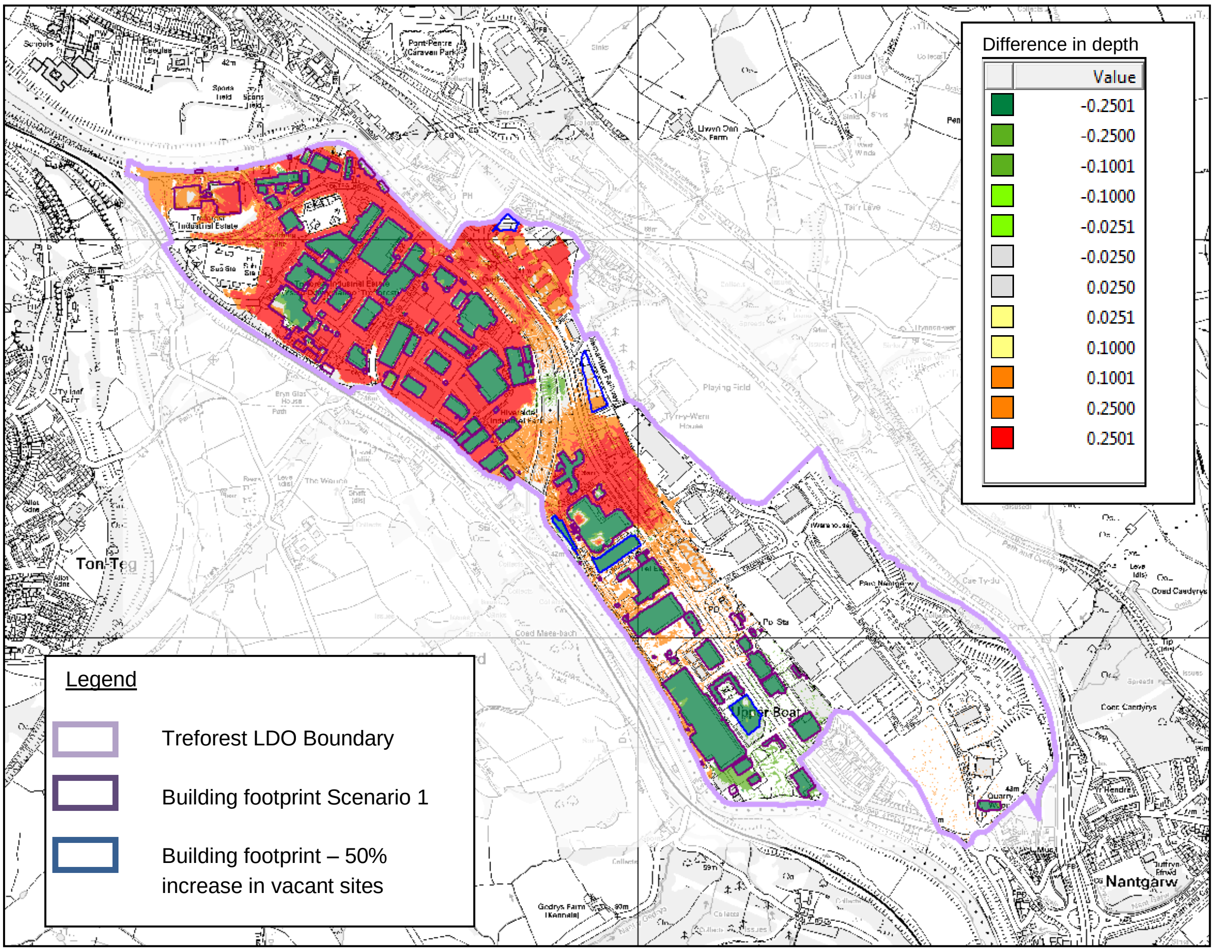


Figure B - 2 – Depth difference between Baseline and Scenario One – 1 in 1000 year event (difference grid scenario one minus the baseline)

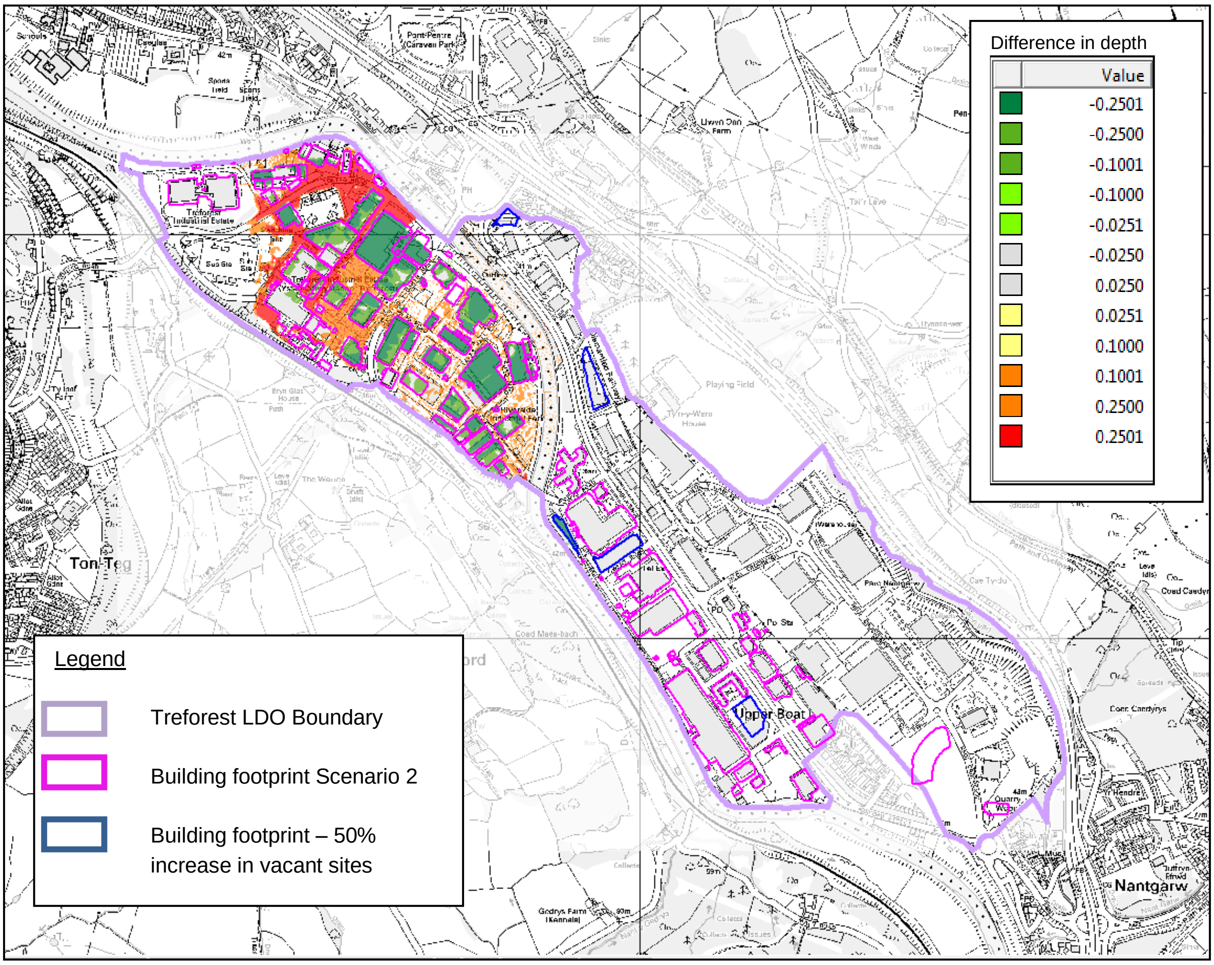


Figure B - 3 – Depth difference between Baseline and Scenario Two – 1 in 100 year event (difference grid scenario two minus baseline)

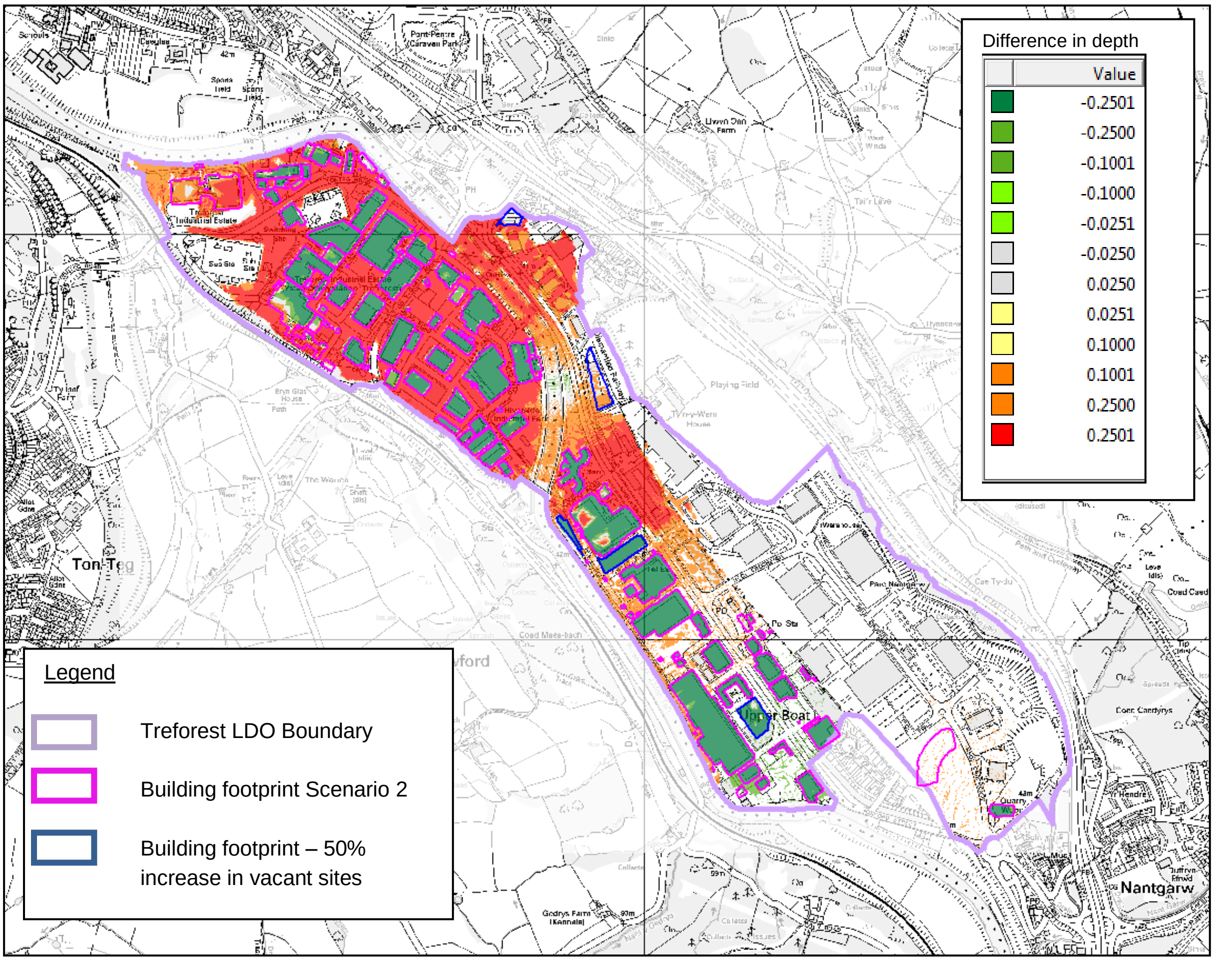


Figure B - 4 – Depth difference between Baseline and Scenario Two – 1 in 1000 year event (difference grid scenario two minus baseline)

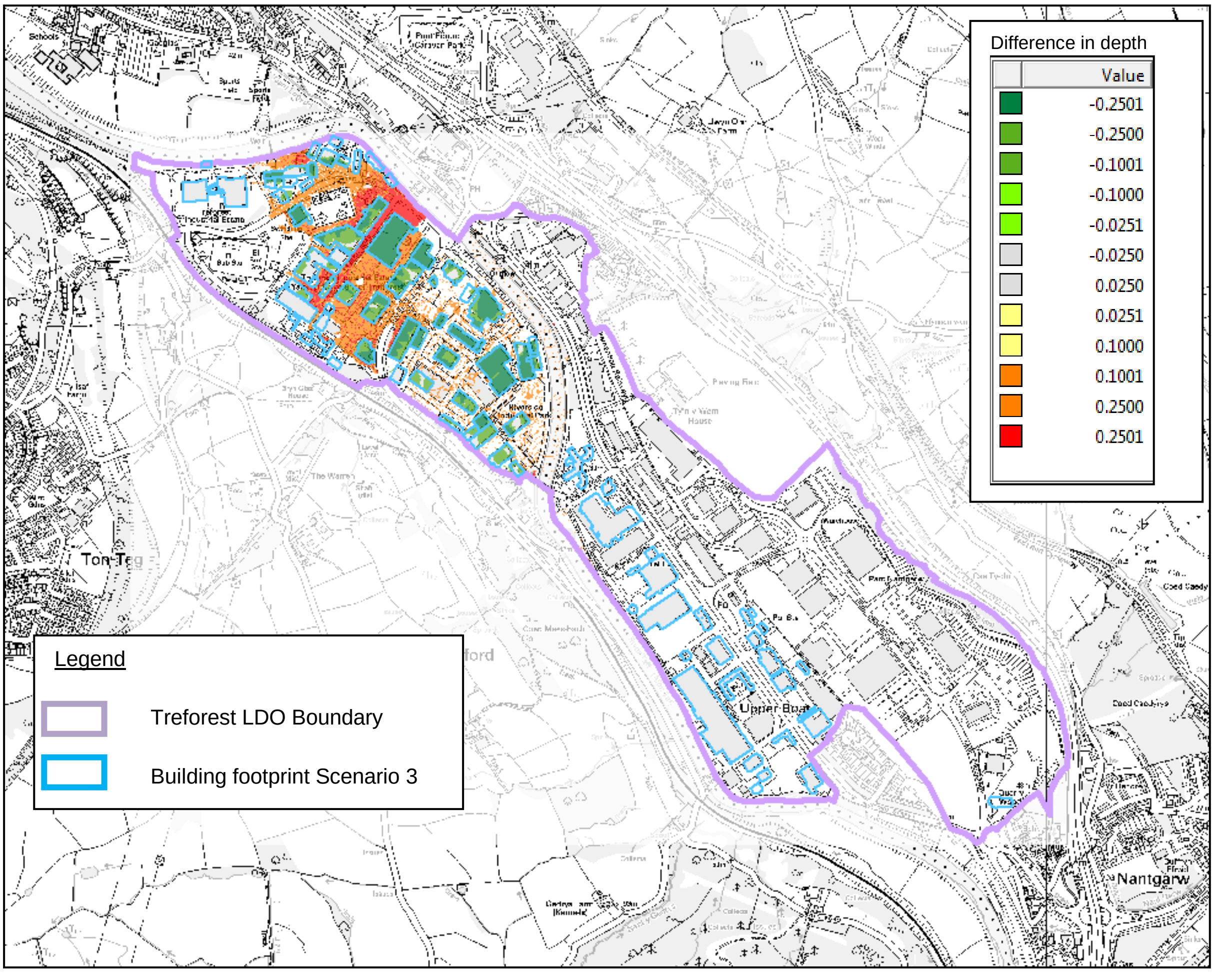


Figure B - 5 – Depth difference between Baseline and Scenario Three – 1 in 100 year event (difference grid scenario three minus baseline)

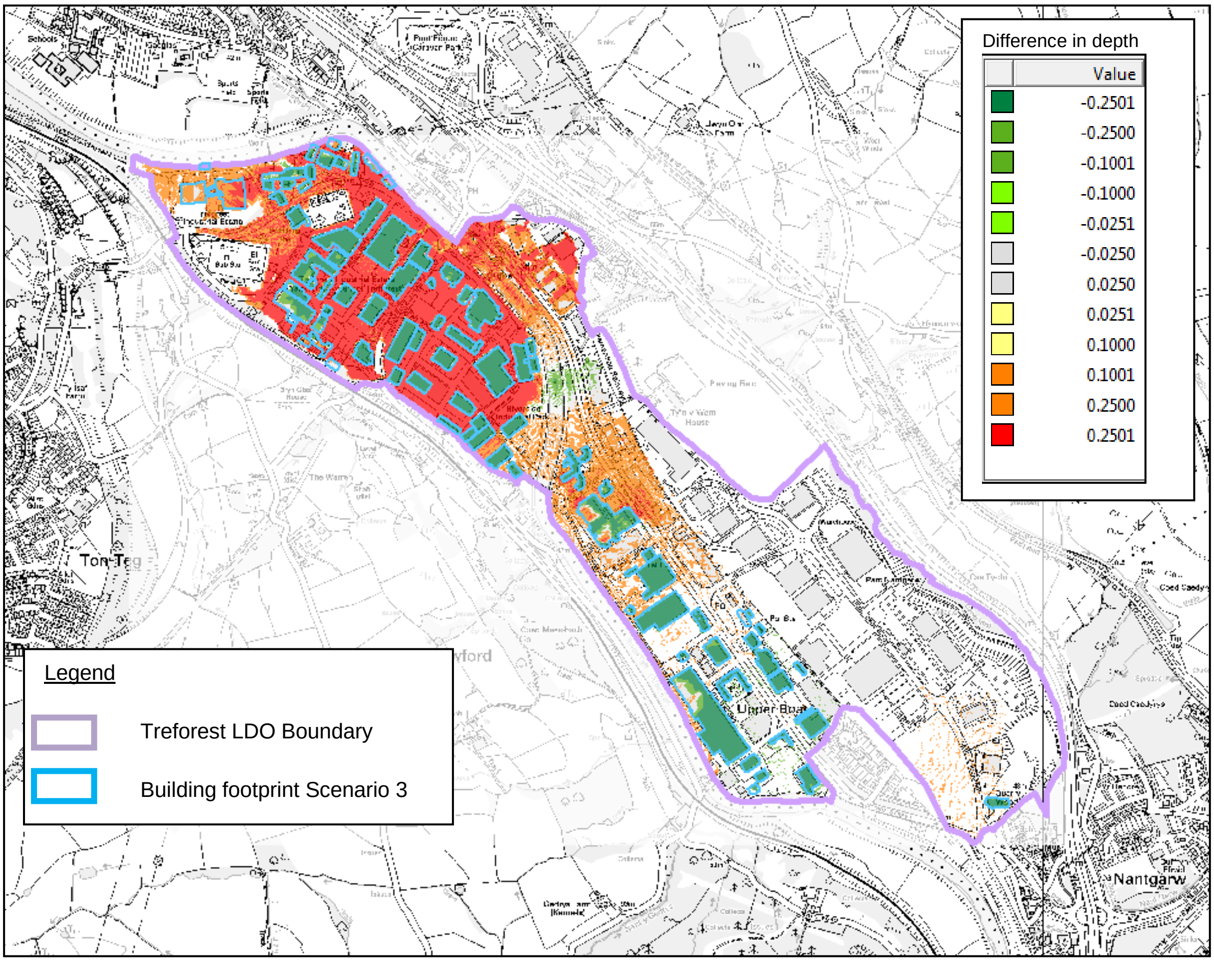


Figure B - 6 – Depth difference between Baseline and Scenario Three – 1 in 1000 year event (difference grid scenario three minus baseline)

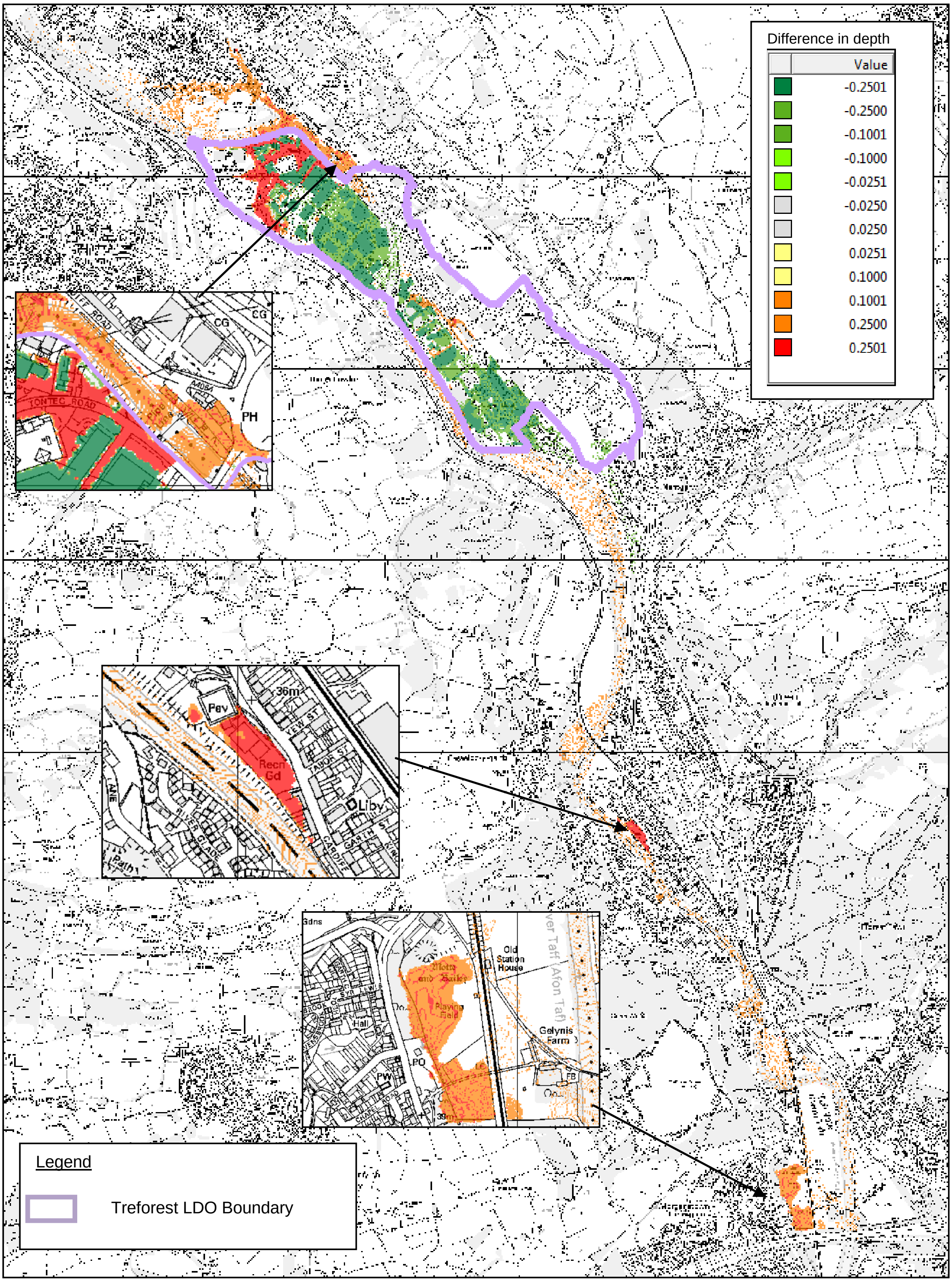


Figure B - 7 – Depth difference between Baseline and Scenario Two – 1 in 100 year plus climate change event (difference grid scenario two minus baseline)

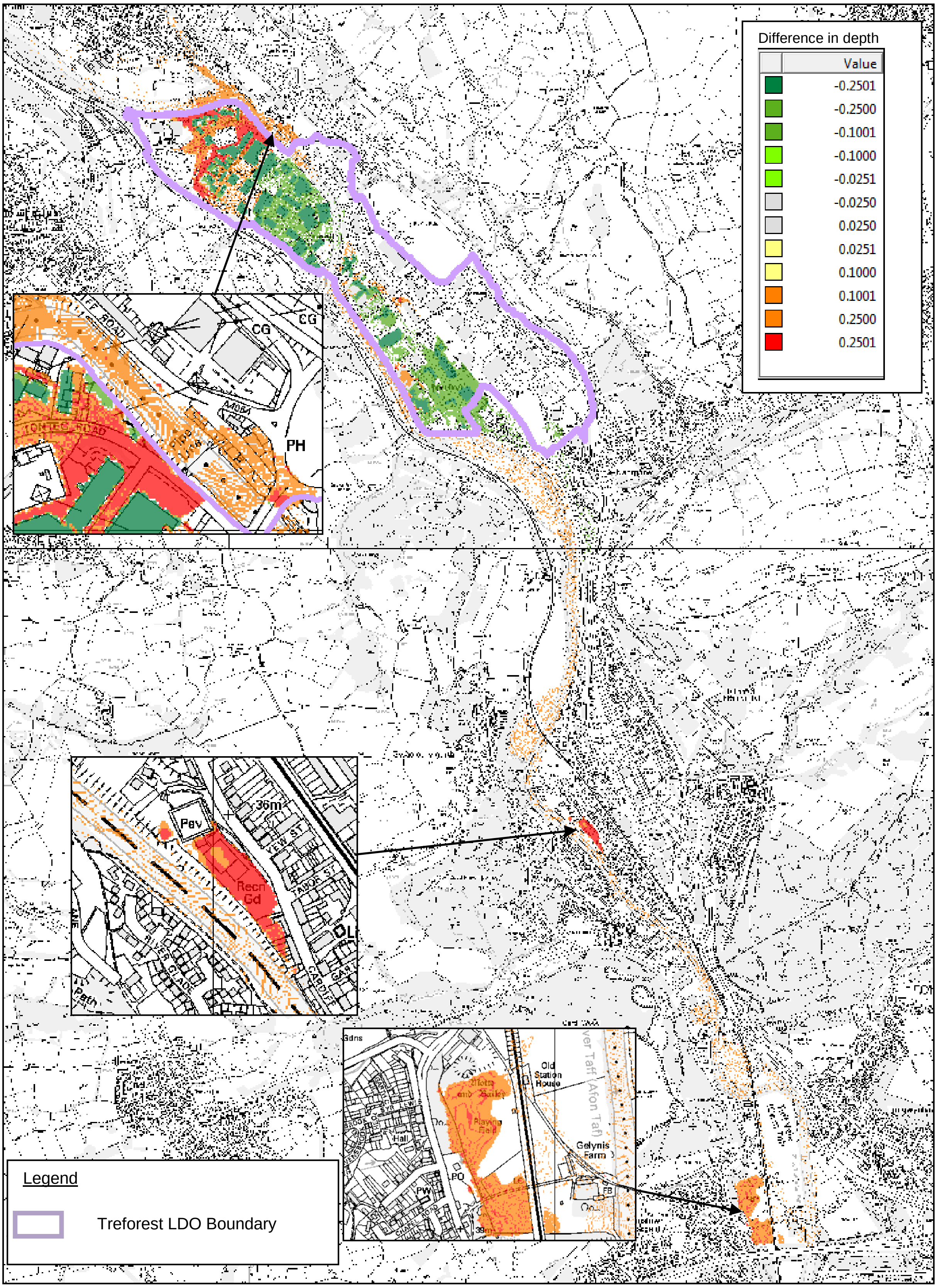


Figure B - 8 – Depth difference between Baseline and Scenario Three – 1 in 100 year plus climate change event (difference grid scenario three minus baseline)